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Kroymann

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(54) **ACCESSORY FOR A SELF-BALANCING BOARD**

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(65) **Prior Publication Data**

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(Continued)

(51) **Int. Cl.**

B62K 5/027 (2013.01)
B62K 13/04 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***B62K 13/04*** (2013.01); ***B62J 1/08*** (2013.01); ***B62K 11/007*** (2016.11); ***B62K 19/30*** (2013.01); ***B62K 21/12*** (2013.01)

(58) **Field of Classification Search**

CPC B62K 13/04; B62K 11/007; B62K 21/12; B62K 19/30; B62J 1/08

See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Millman IP Inc.

(57) **ABSTRACT**

An accessory for a self-balancing board is provided. The self-balancing board comprises a foot-deck having two lateral foot-deck ends. Each lateral foot-deck end is coupled to a motor that drives a wheel in response to an orientation of the lateral foot-deck end relative to a horizontal plane. The accessory includes a chassis, at least one travel surface-contacting element coupled proximal to a first longitudinal end of the chassis to facilitate travel of the chassis over a travel surface, and a seat coupled to the chassis and configured to support a person. The accessory further includes a first foot-deck engagement element proximal to a second longitudinal end of the chassis distal to the first longitudinal end and constructed to engage the foot-deck of the self-balancing board proximal to the first lateral foot-deck end, and a second foot-deck engagement element proximal to the second longitudinal end of the chassis and constructed to engage the foot-deck of the self-balancing board proximal to the second lateral foot-deck end. At least one control member coupled to the first foot-deck engagement element and

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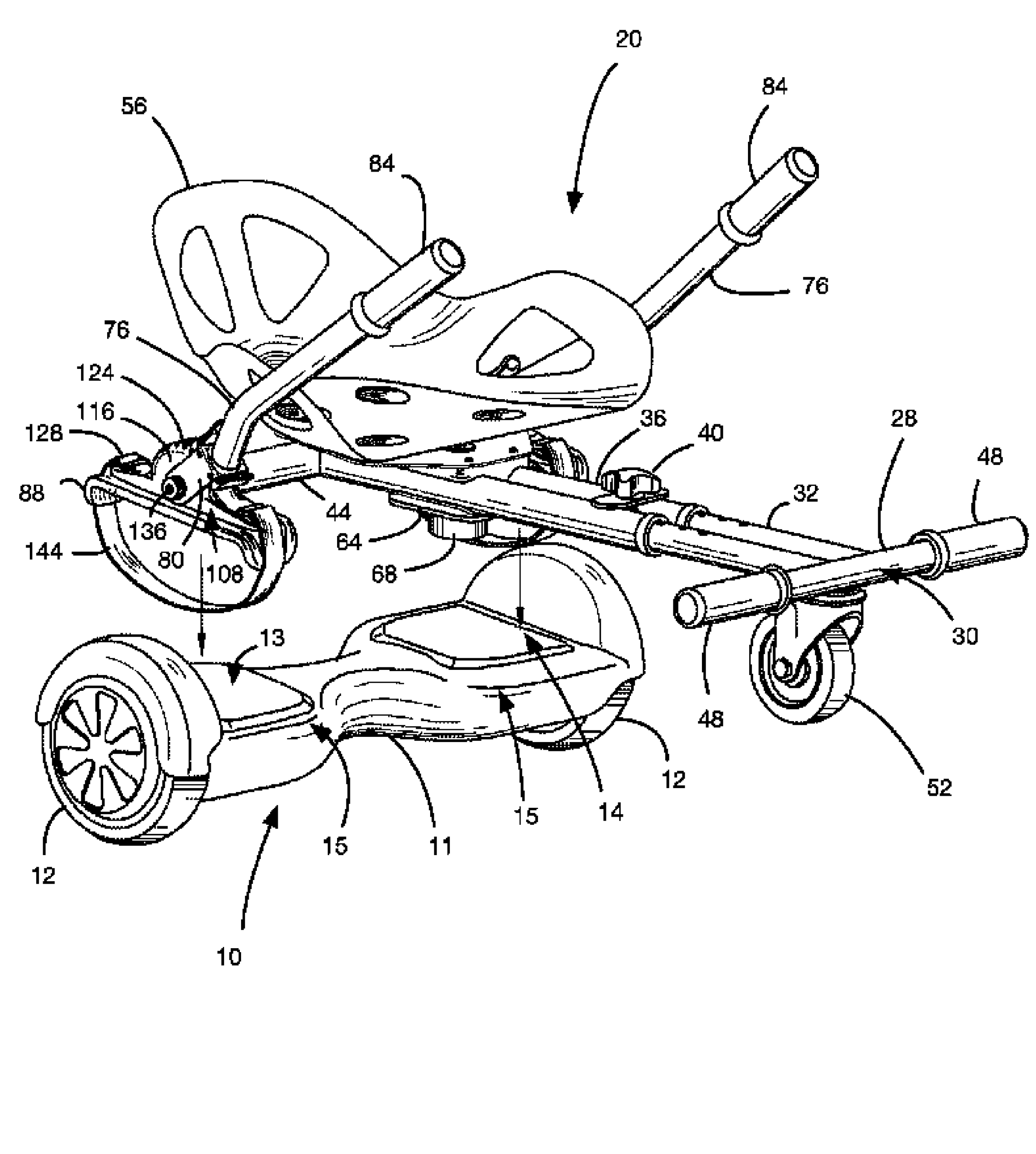

the second foot-deck engagement element controls the orientation of the lateral foot-deck ends relative to a horizontal plane via the first foot-deck engagement element and the second foot-deck engagement element.

19 Claims, 20 Drawing Sheets

Related U.S. Application Data

(60) Provisional application No. 62/290,704, filed on Feb. 3, 2016.

(51) **Int. Cl.**

B62K 11/00	(2006.01)
B62J 1/08	(2006.01)
B62K 21/12	(2006.01)
B62K 19/30	(2006.01)

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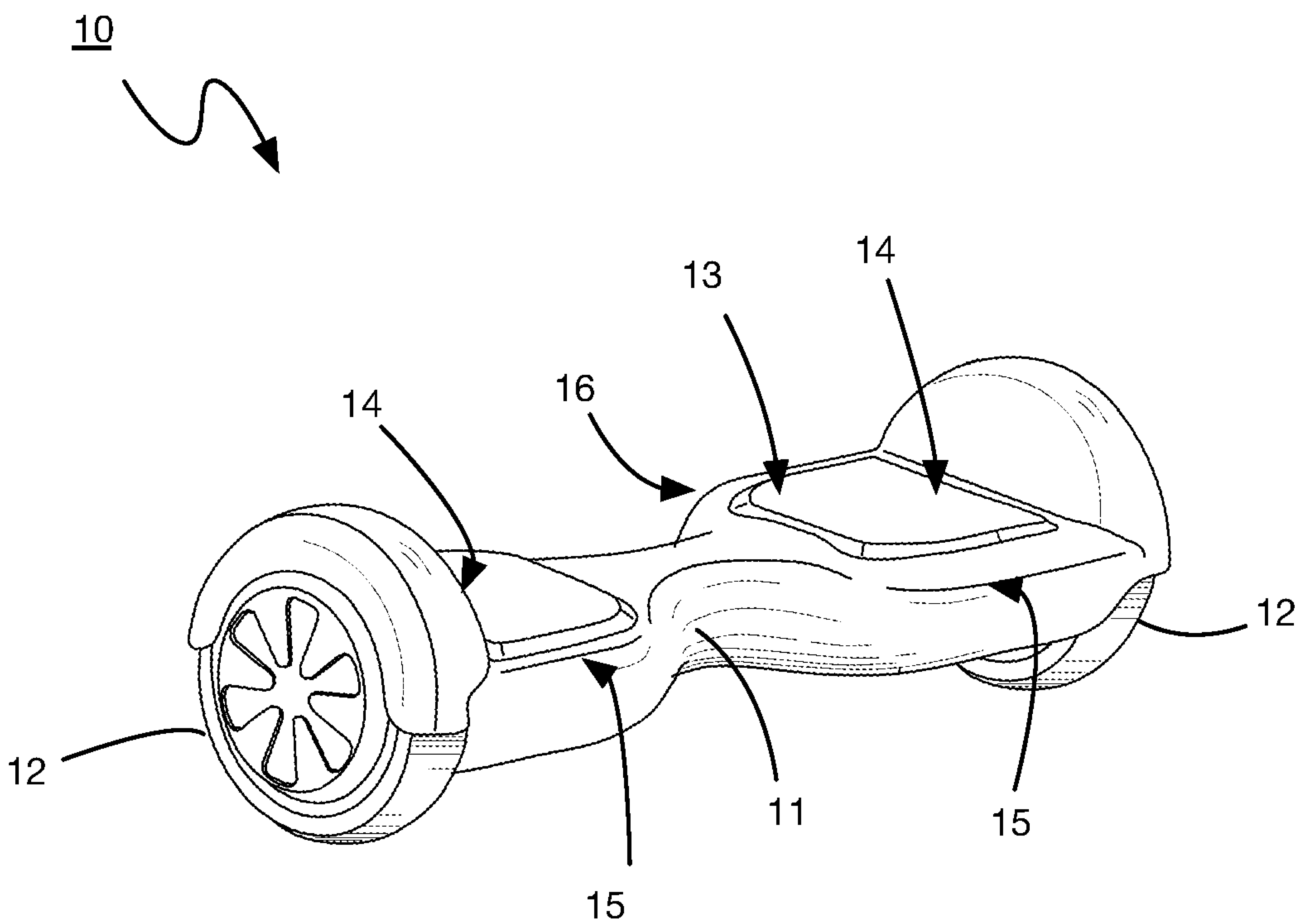

FIG. 1

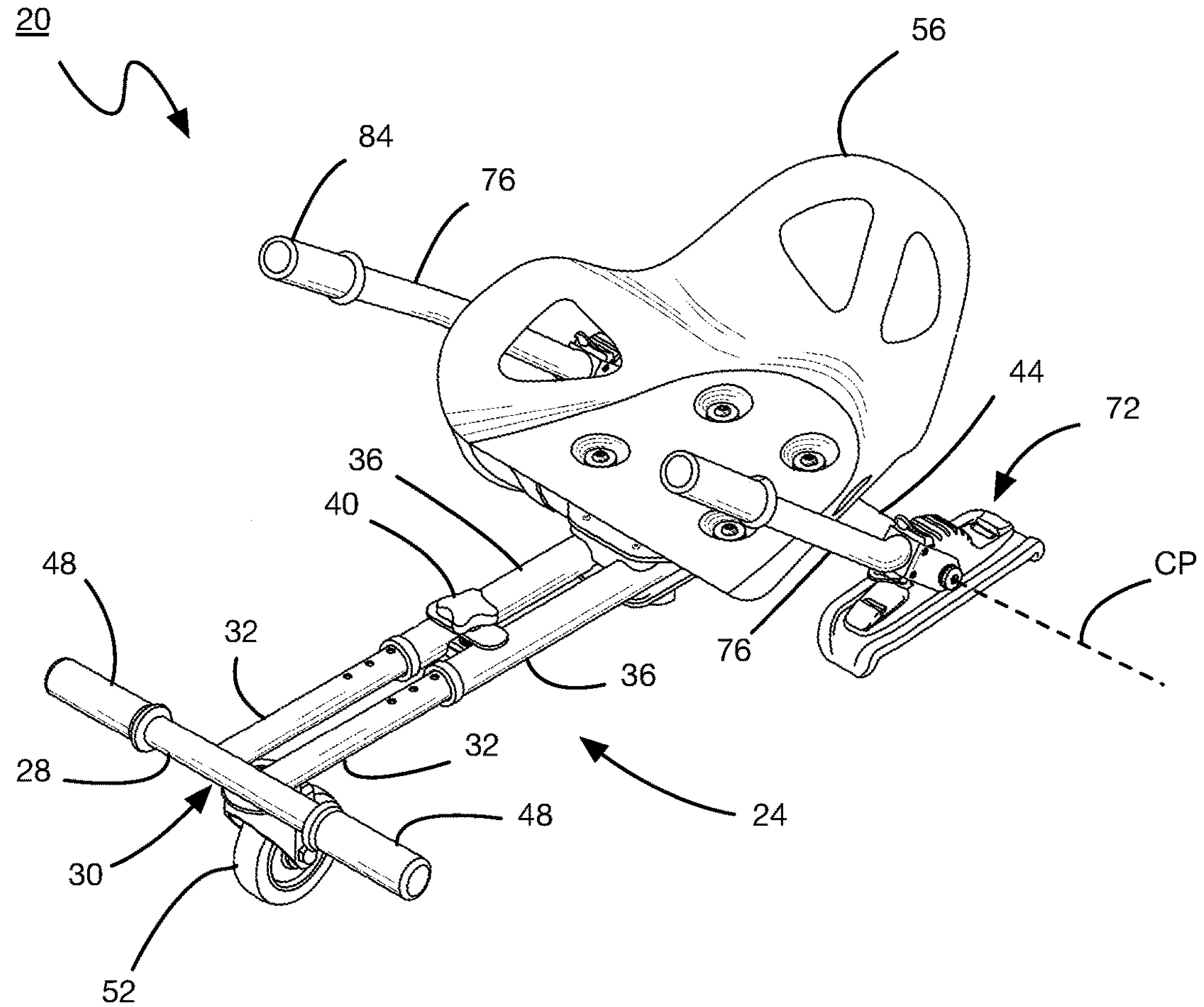

FIG. 2

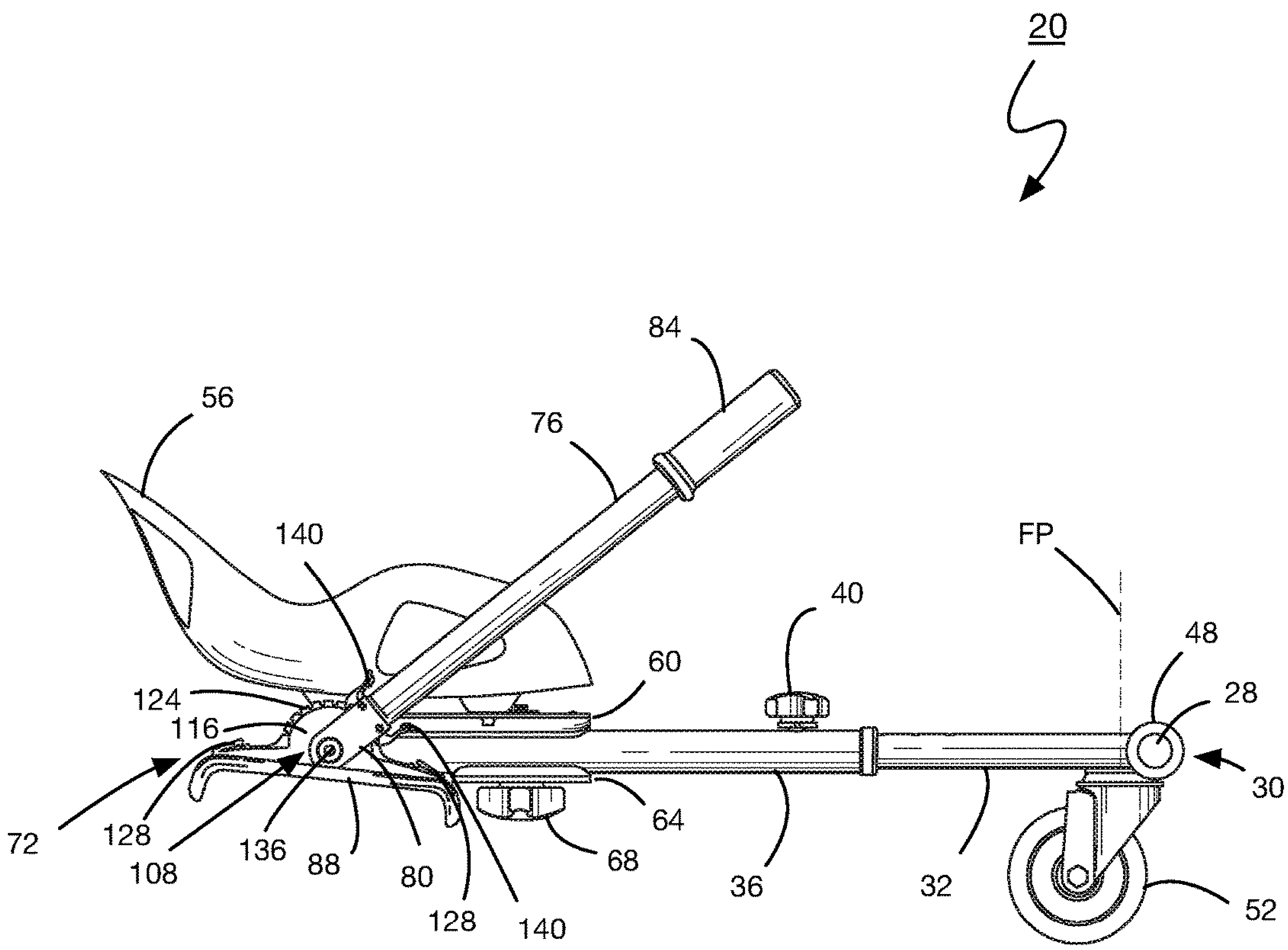

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FIG. 3

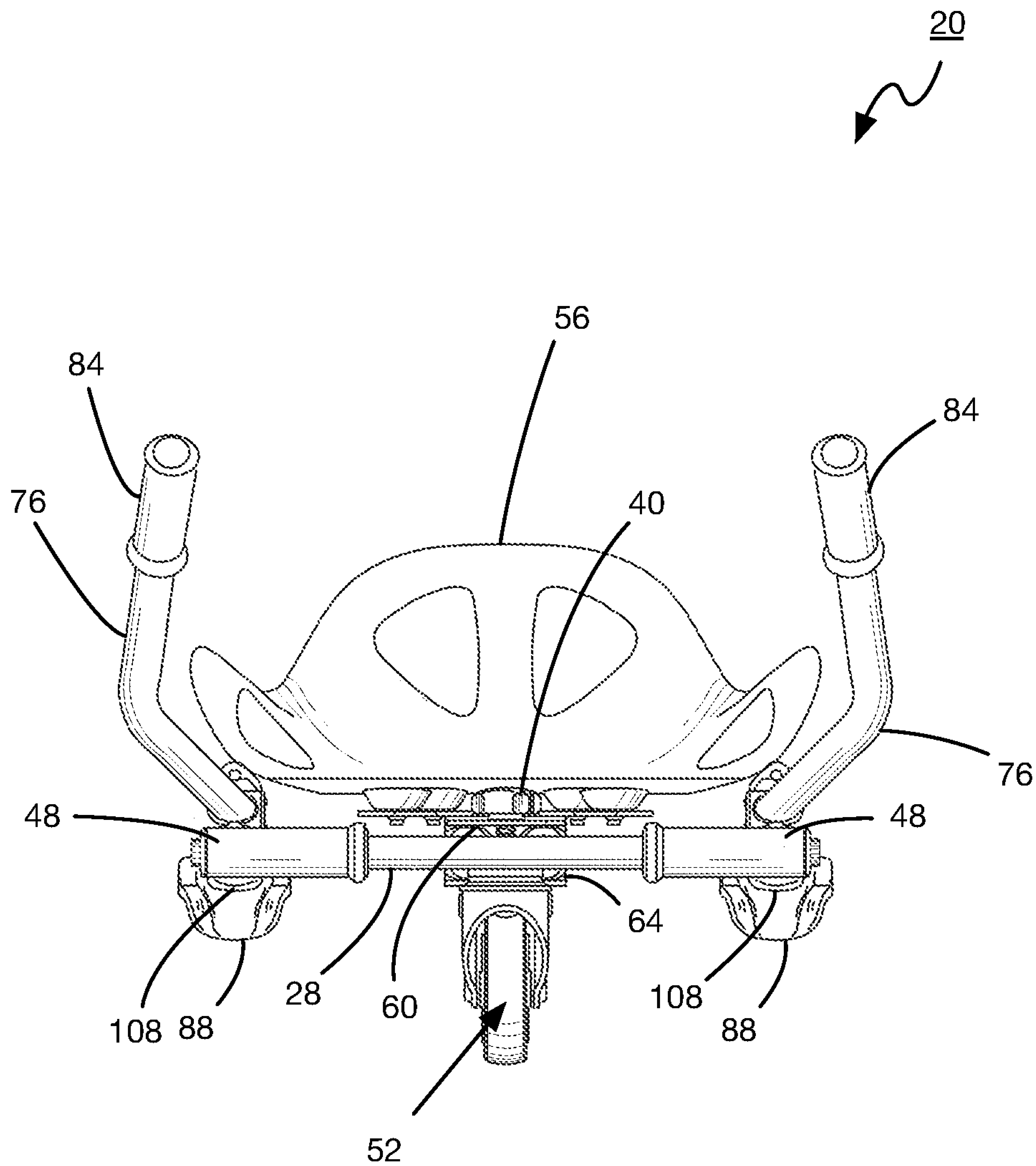

FIG. 4

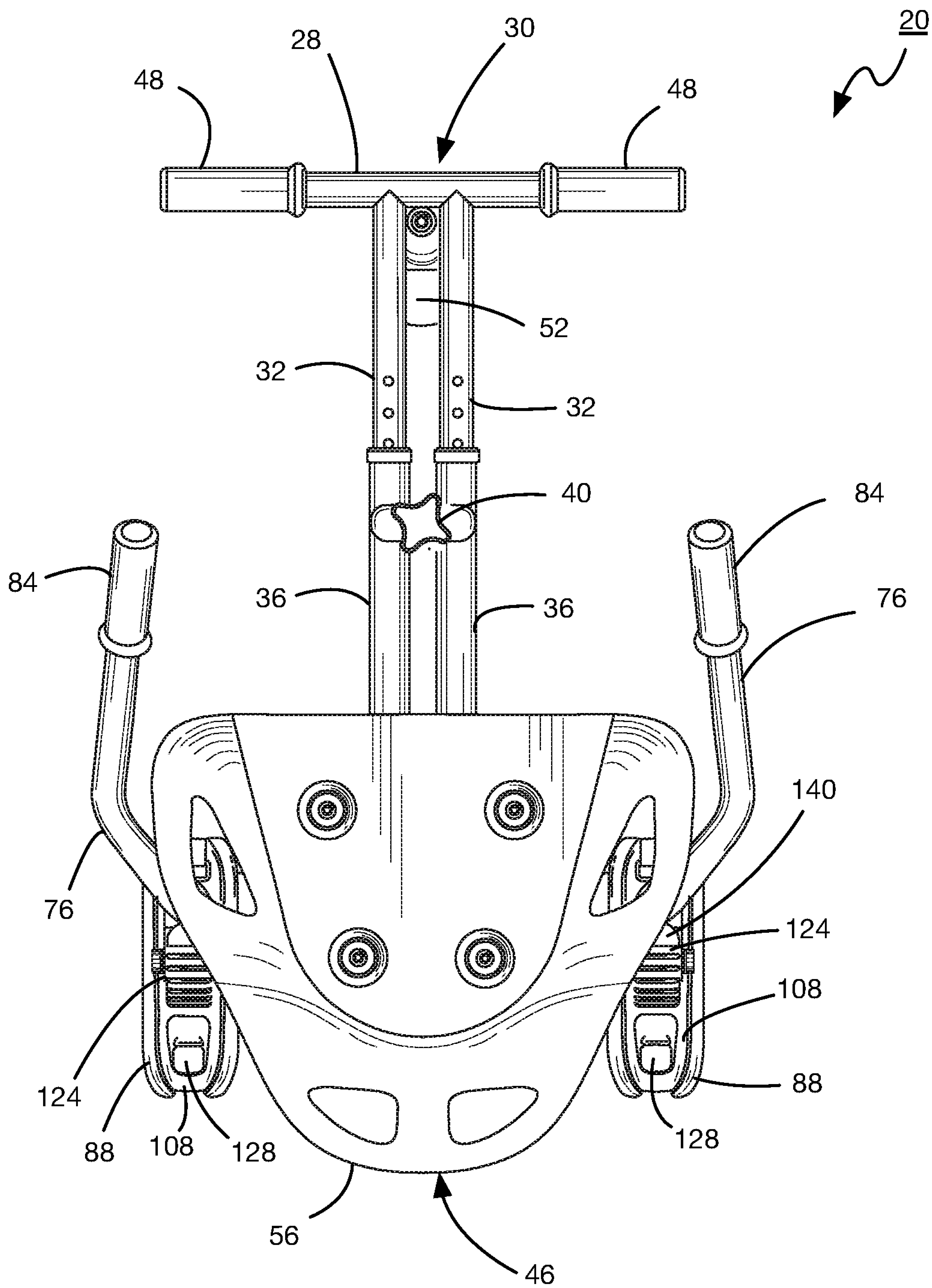
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FIG. 5

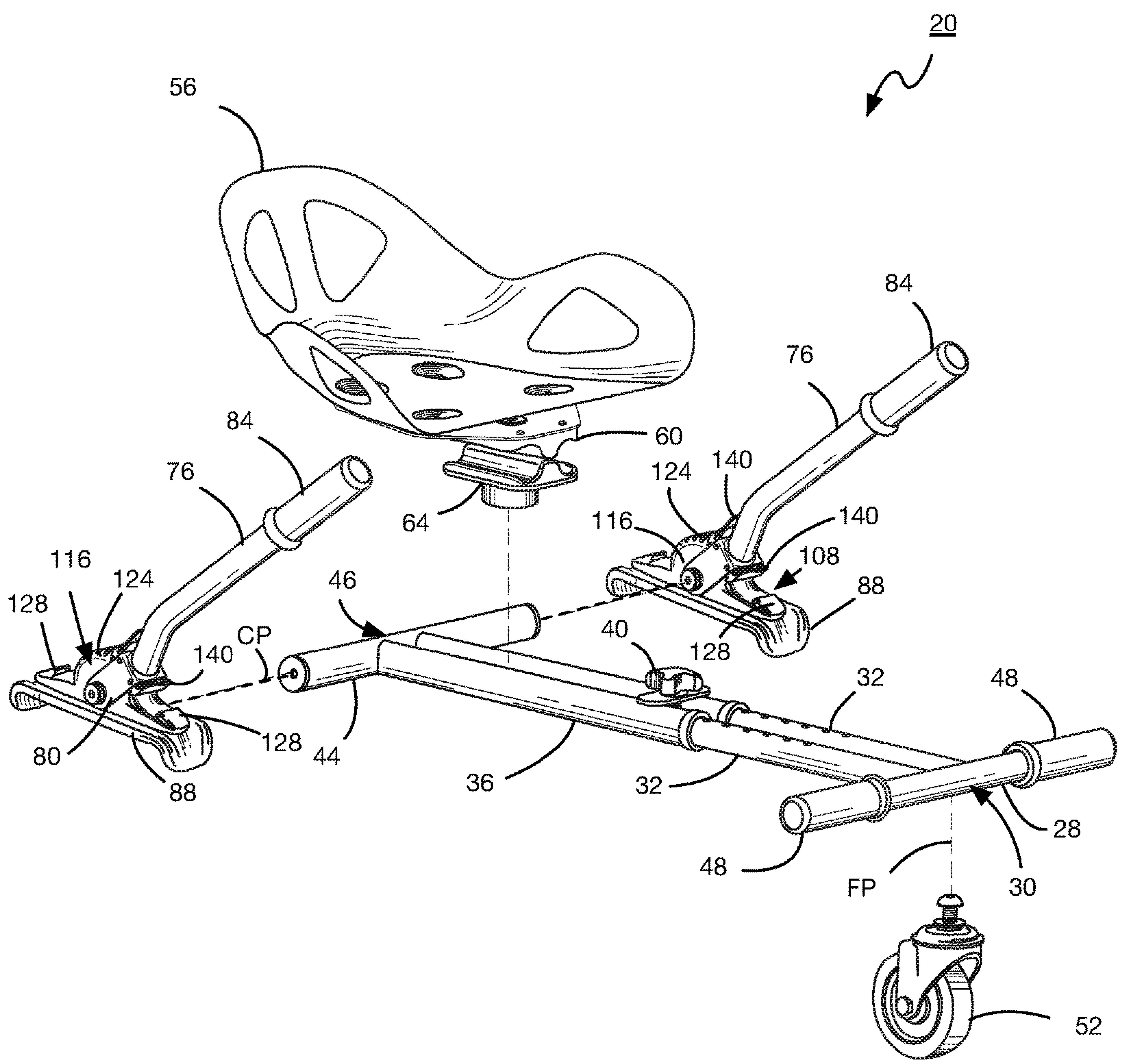
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FIG. 6

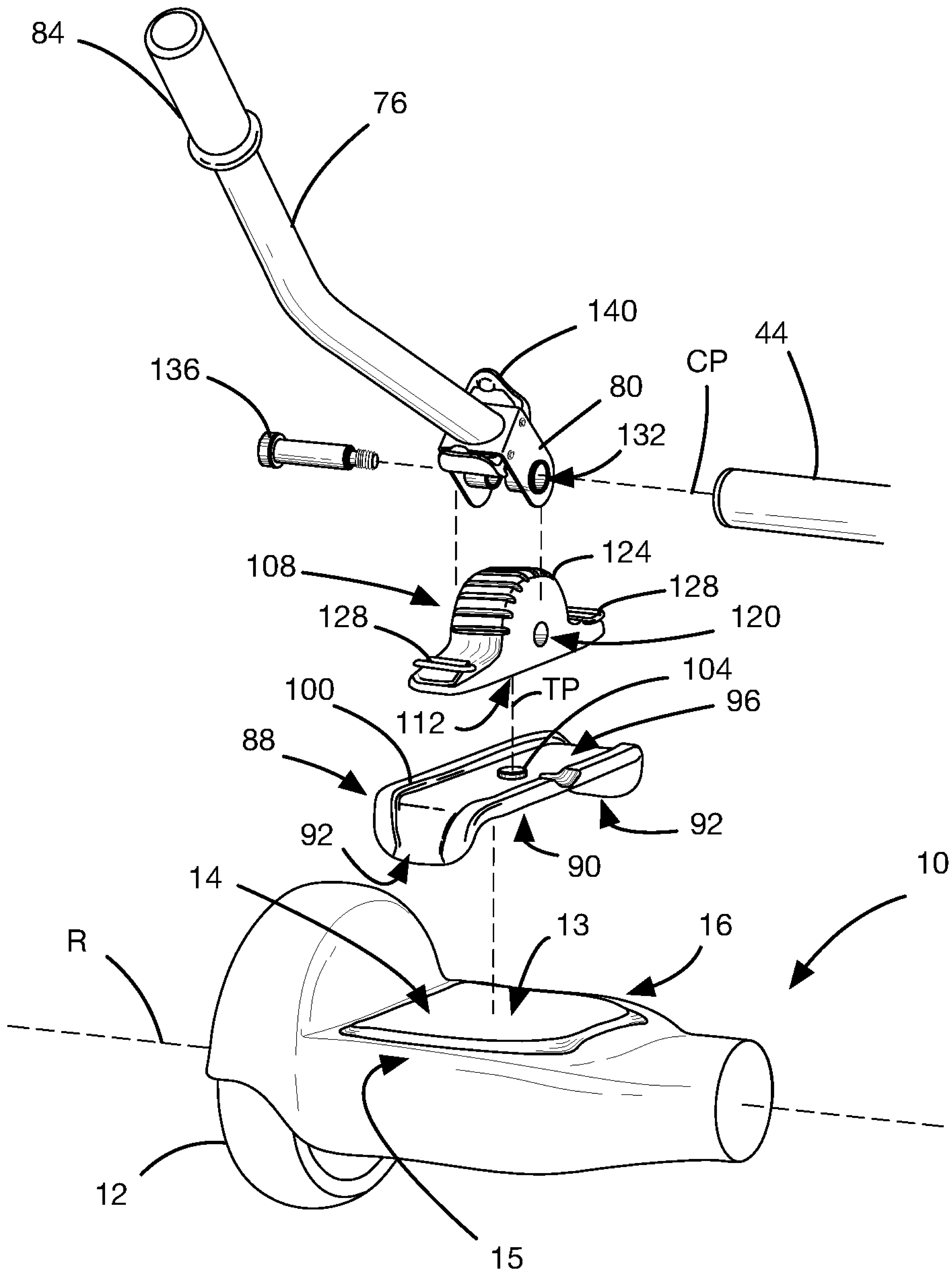
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FIG. 7

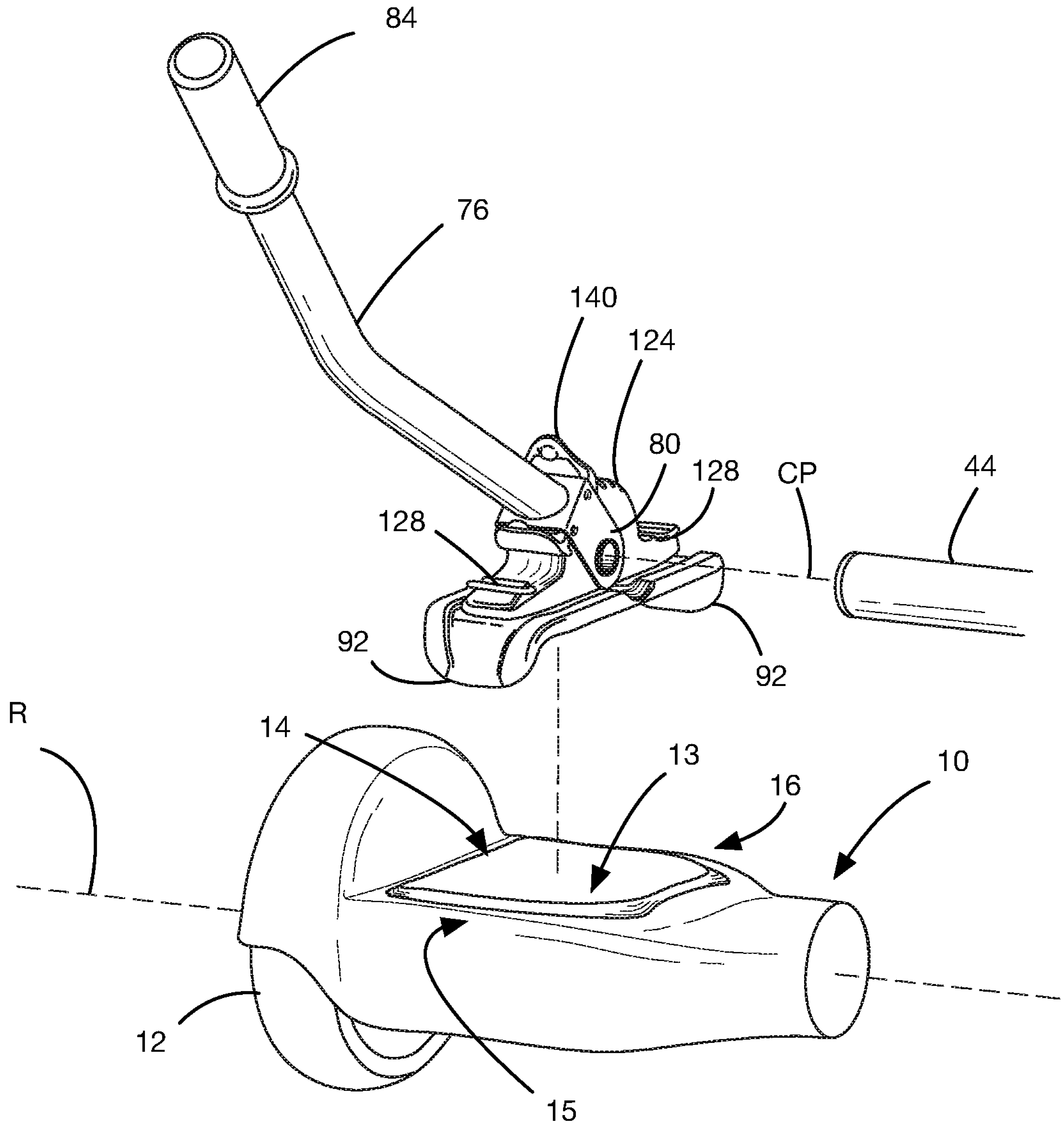

FIG. 8

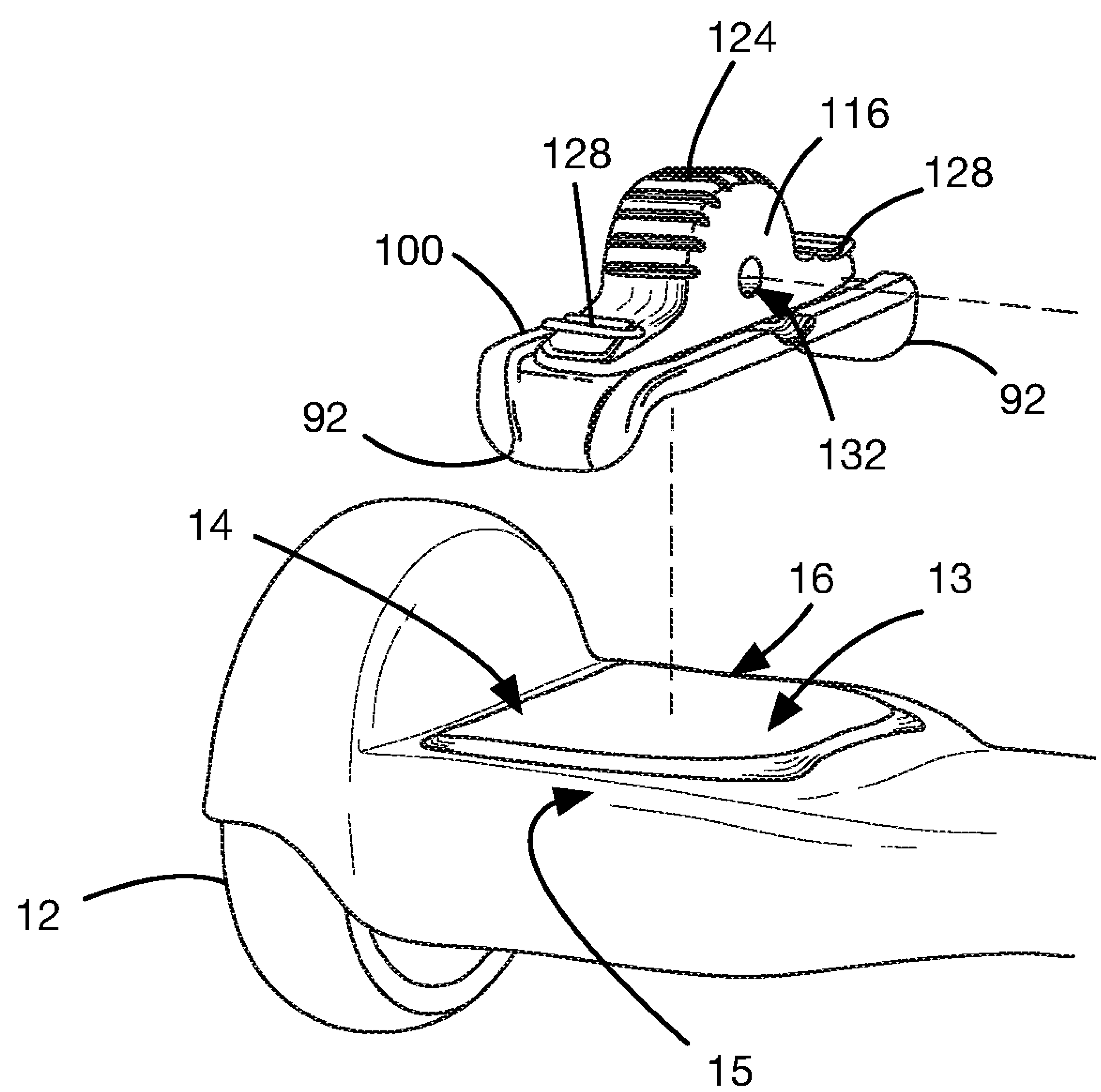

FIG. 9

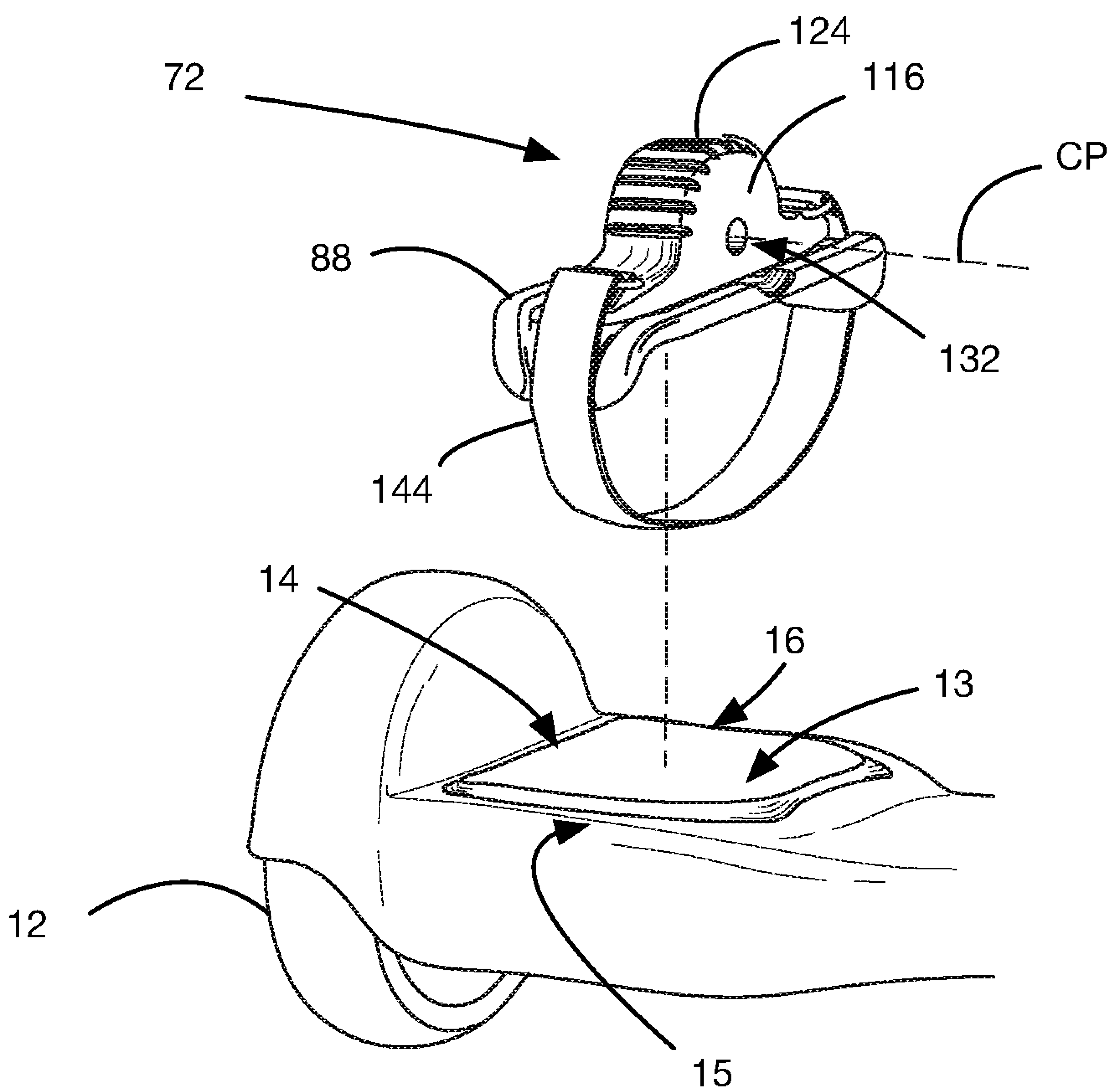

FIG. 10

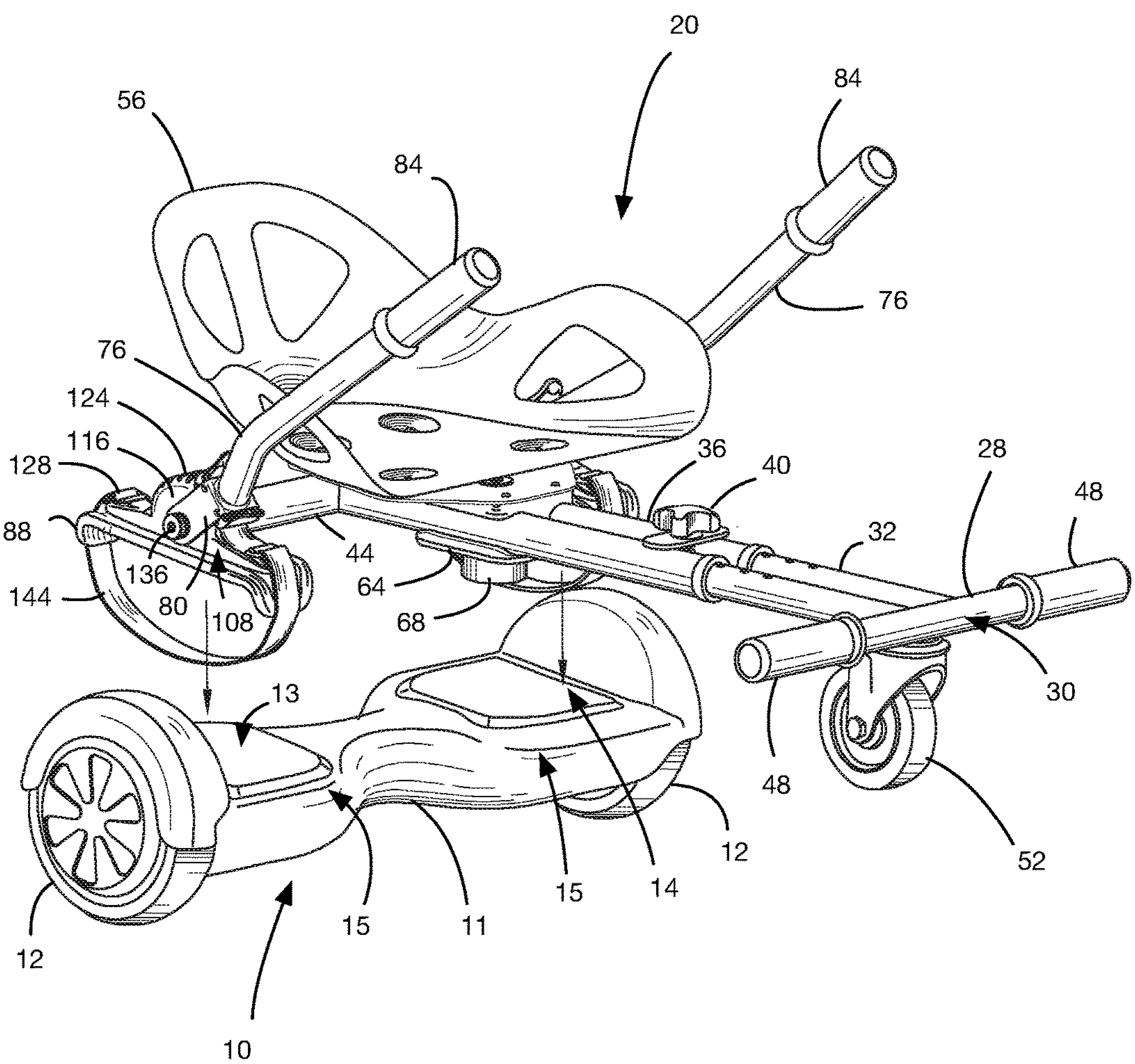
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FIG. 11

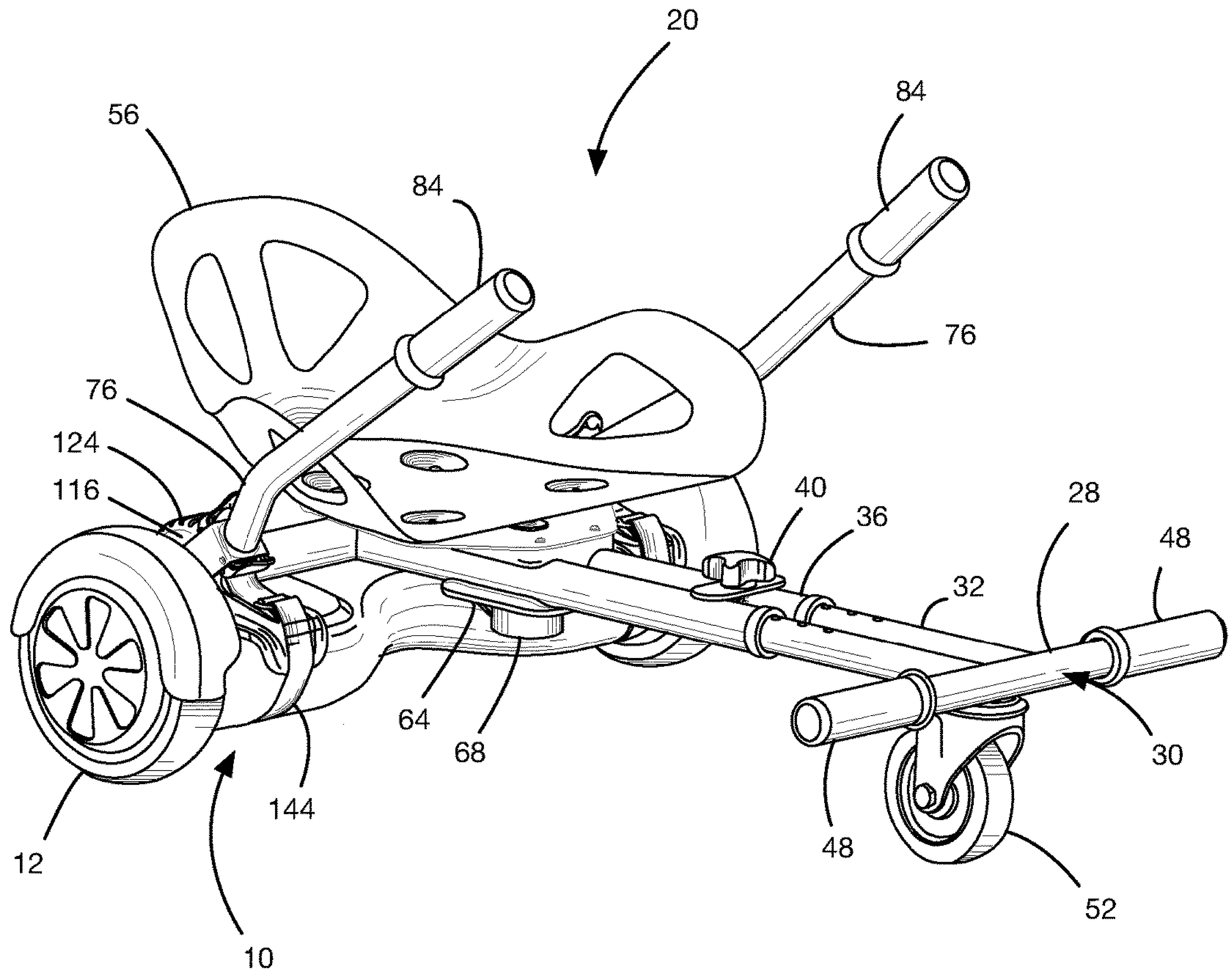

FIG. 12

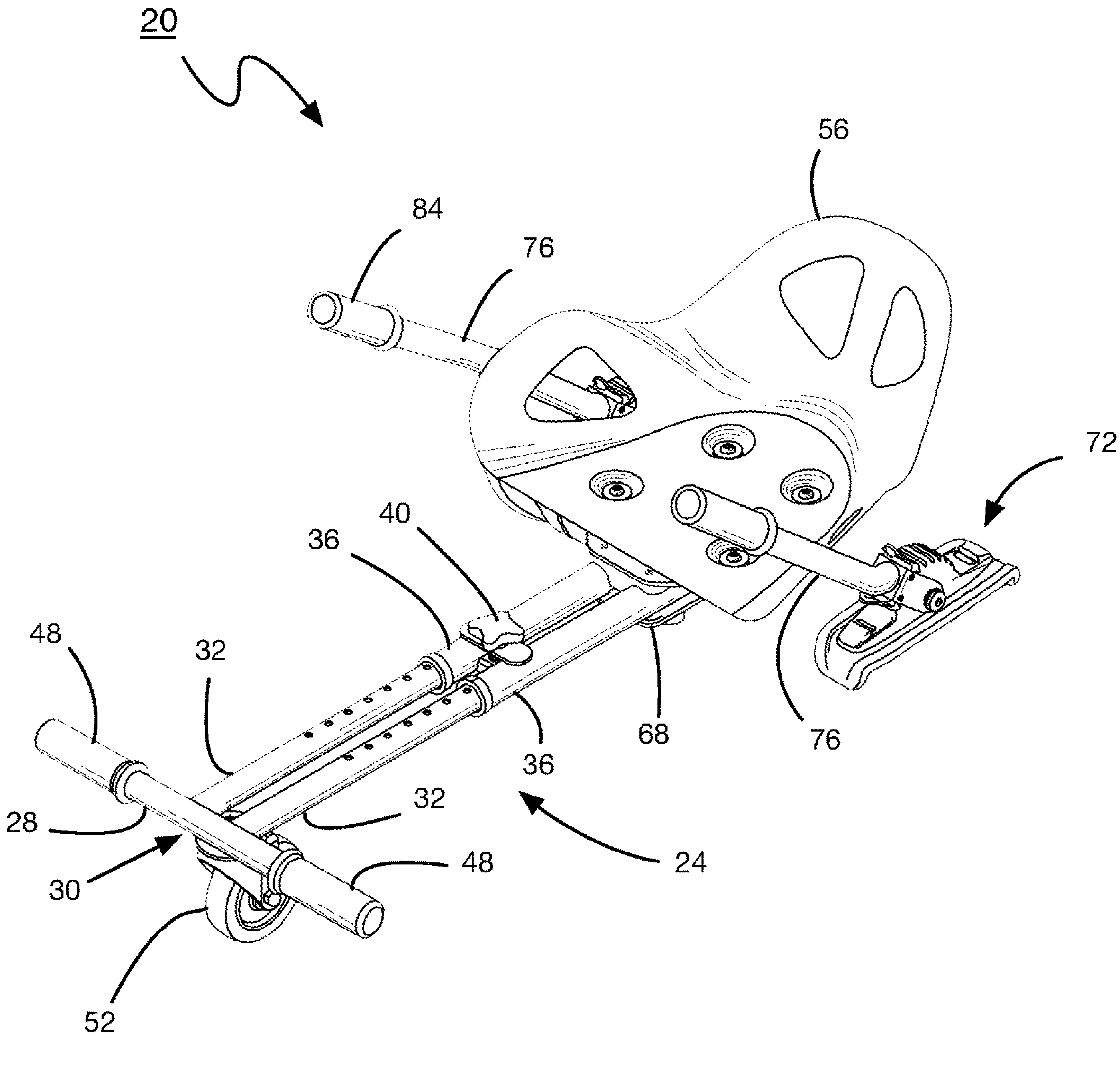

FIG. 13

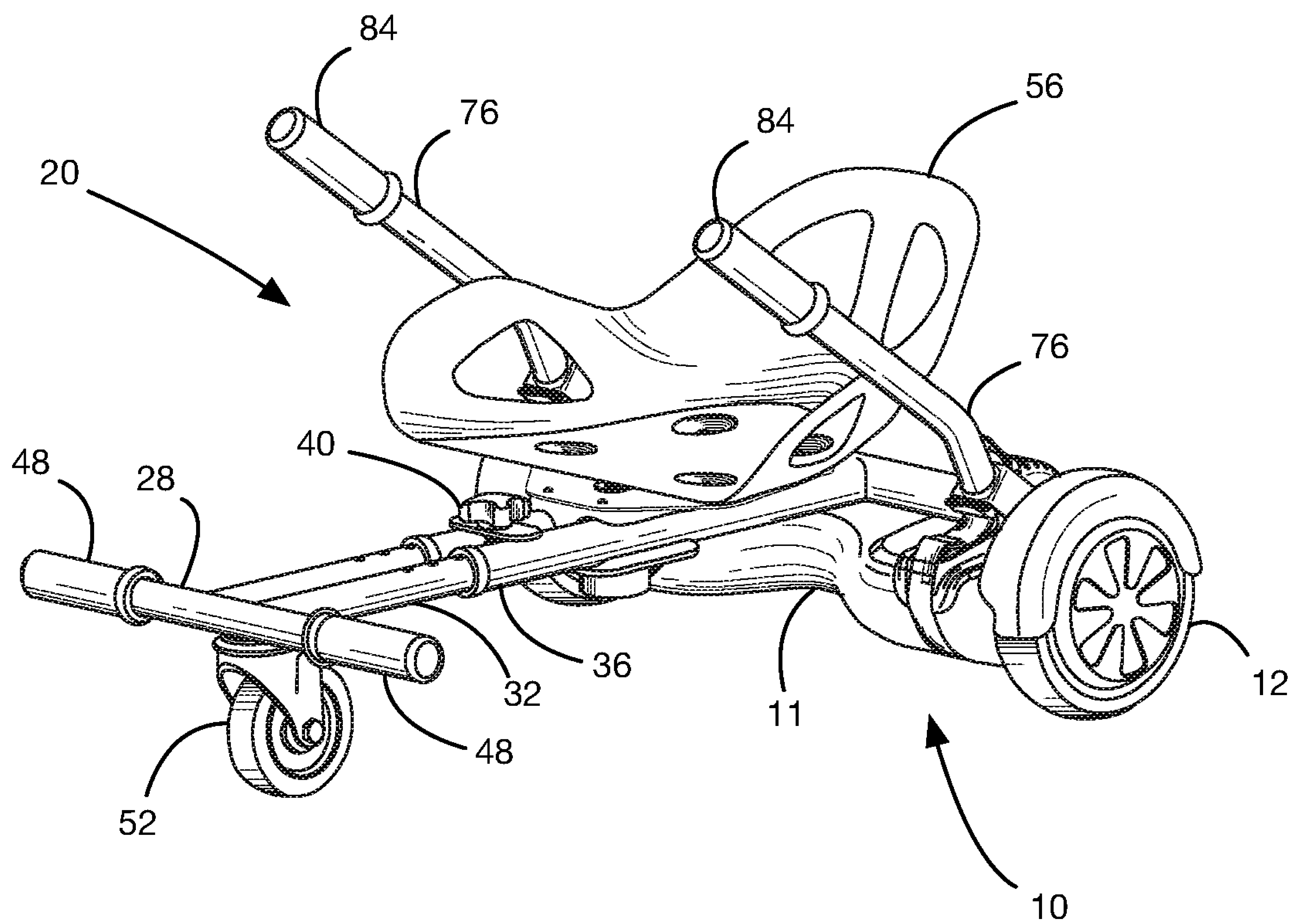

FIG. 14

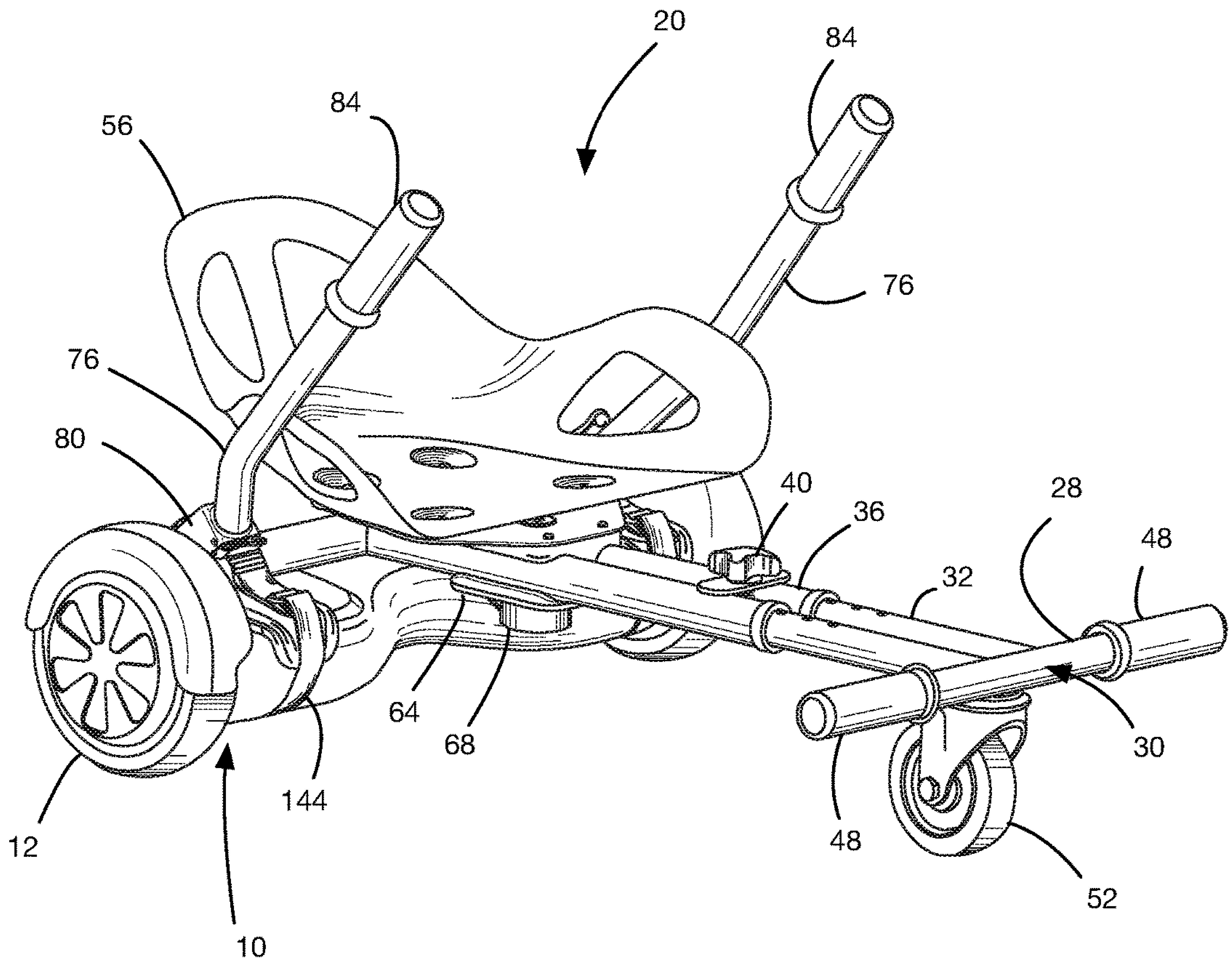

FIG. 15

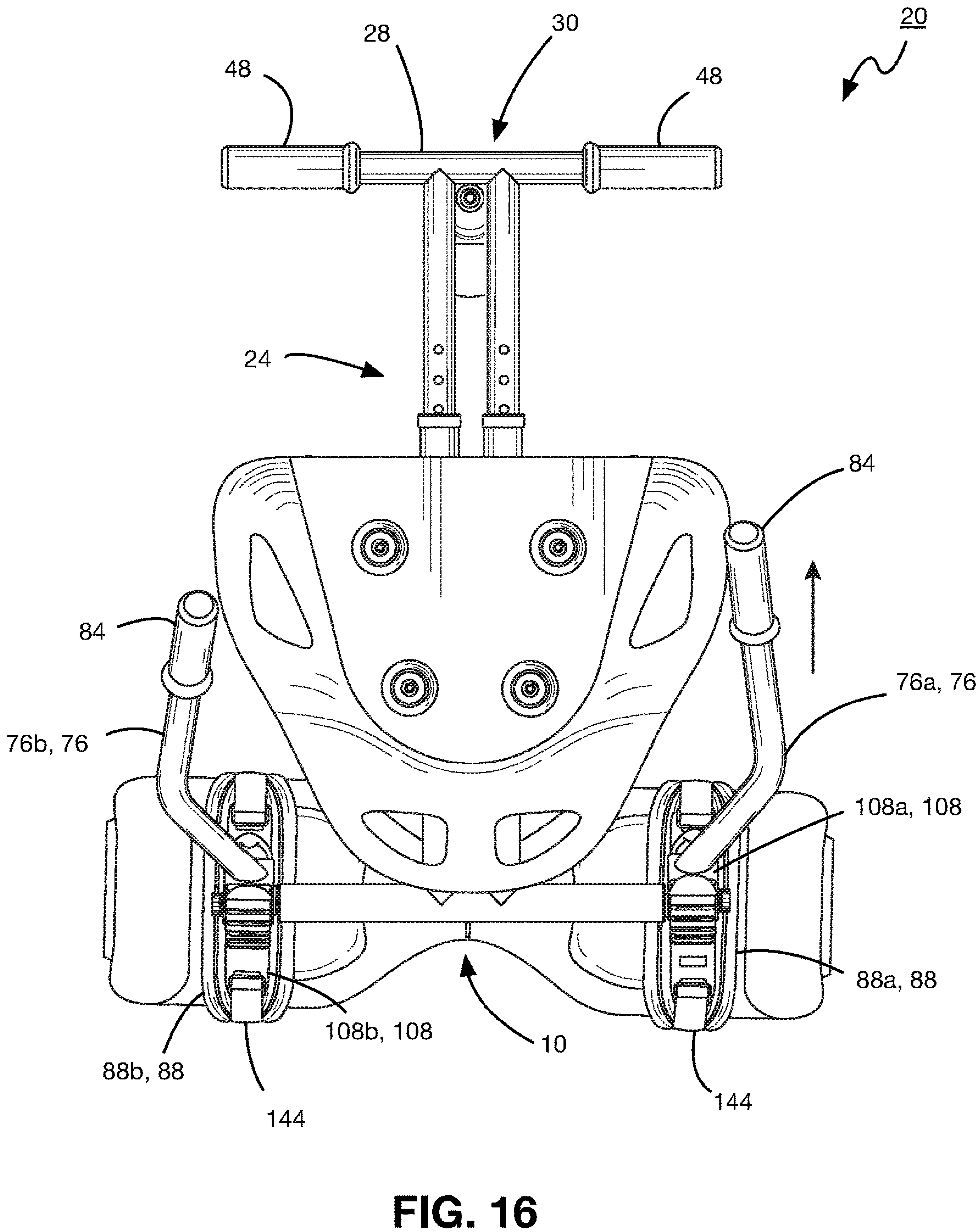
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FIG. 16

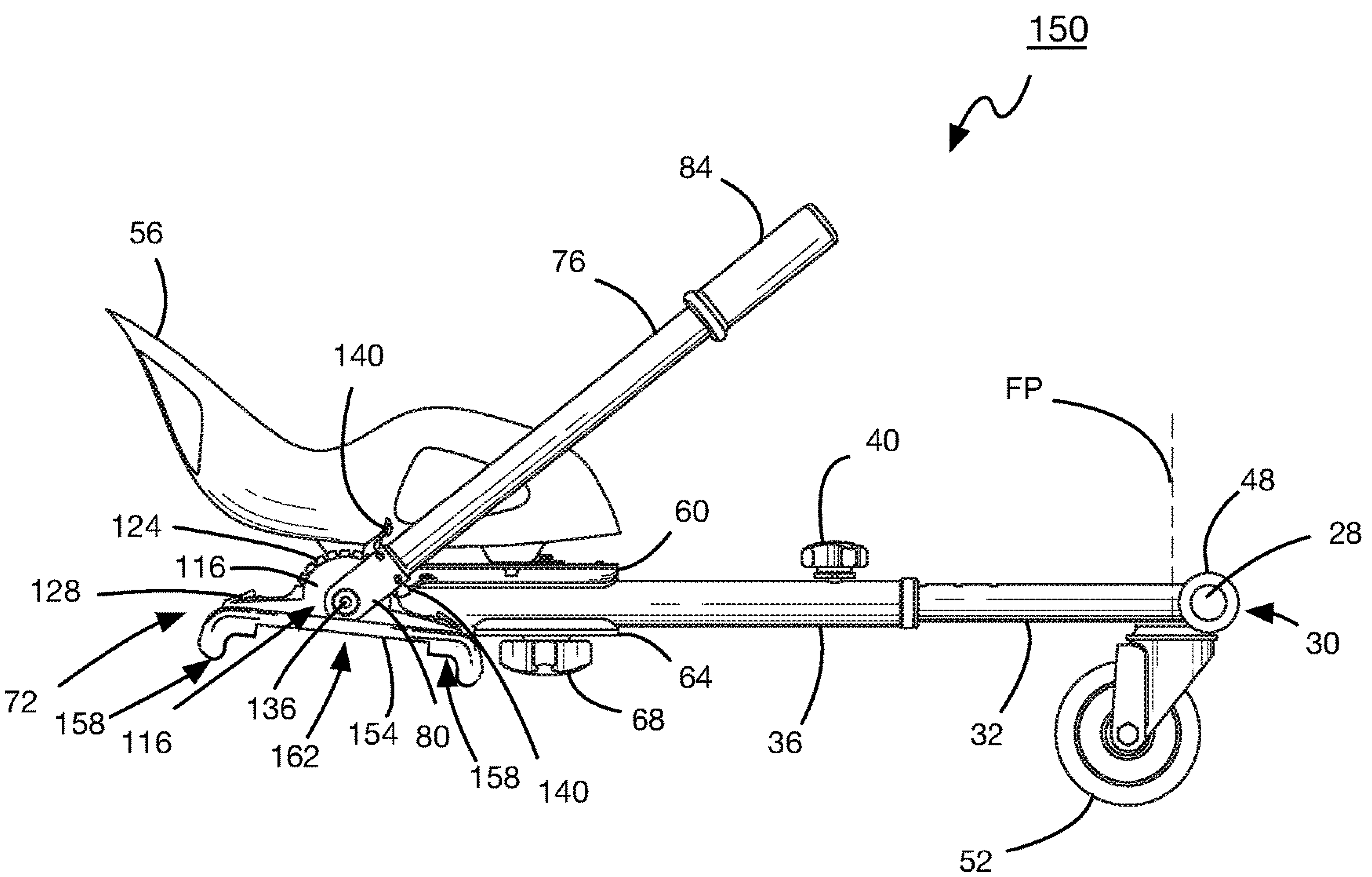
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FIG. 17

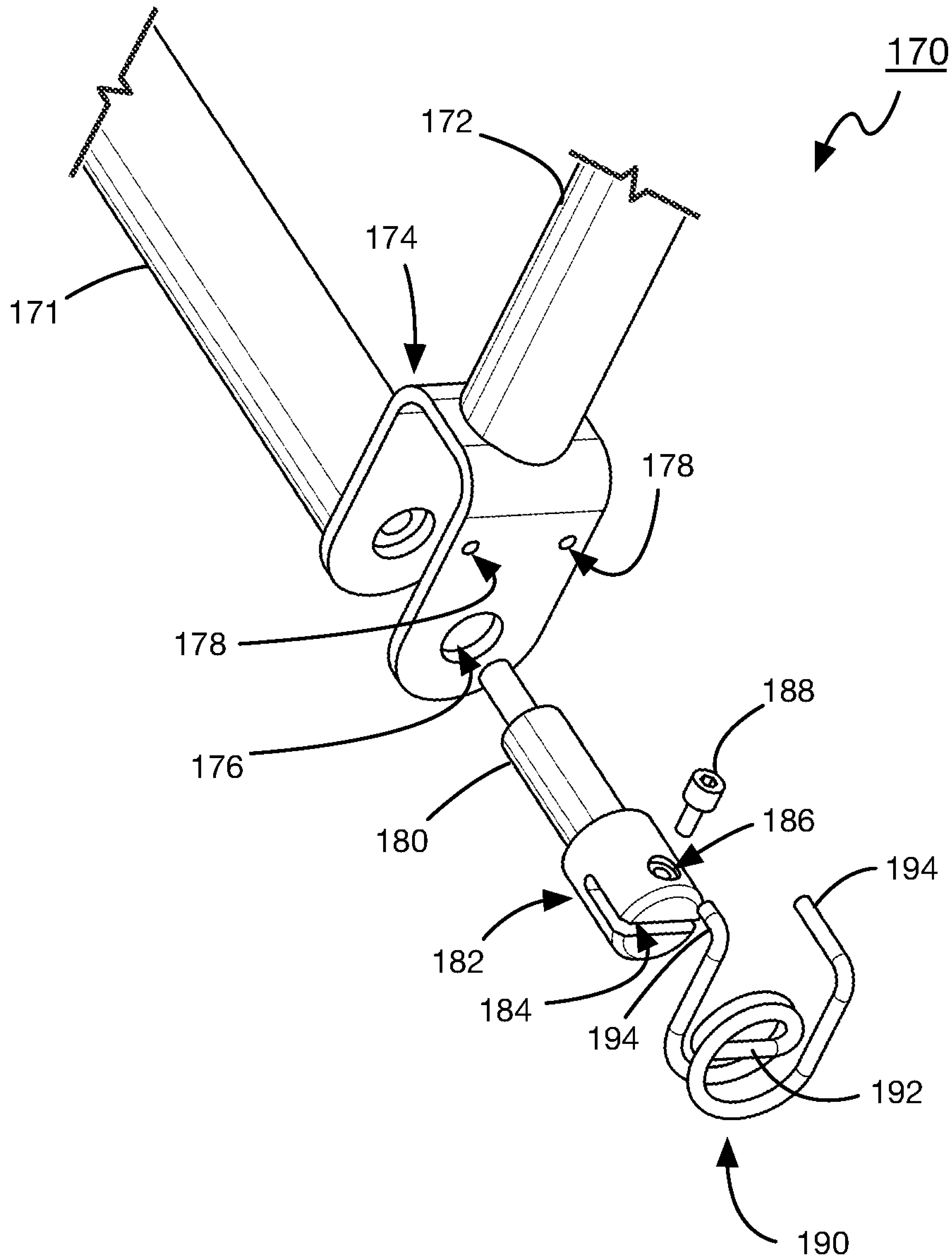

FIG. 18A

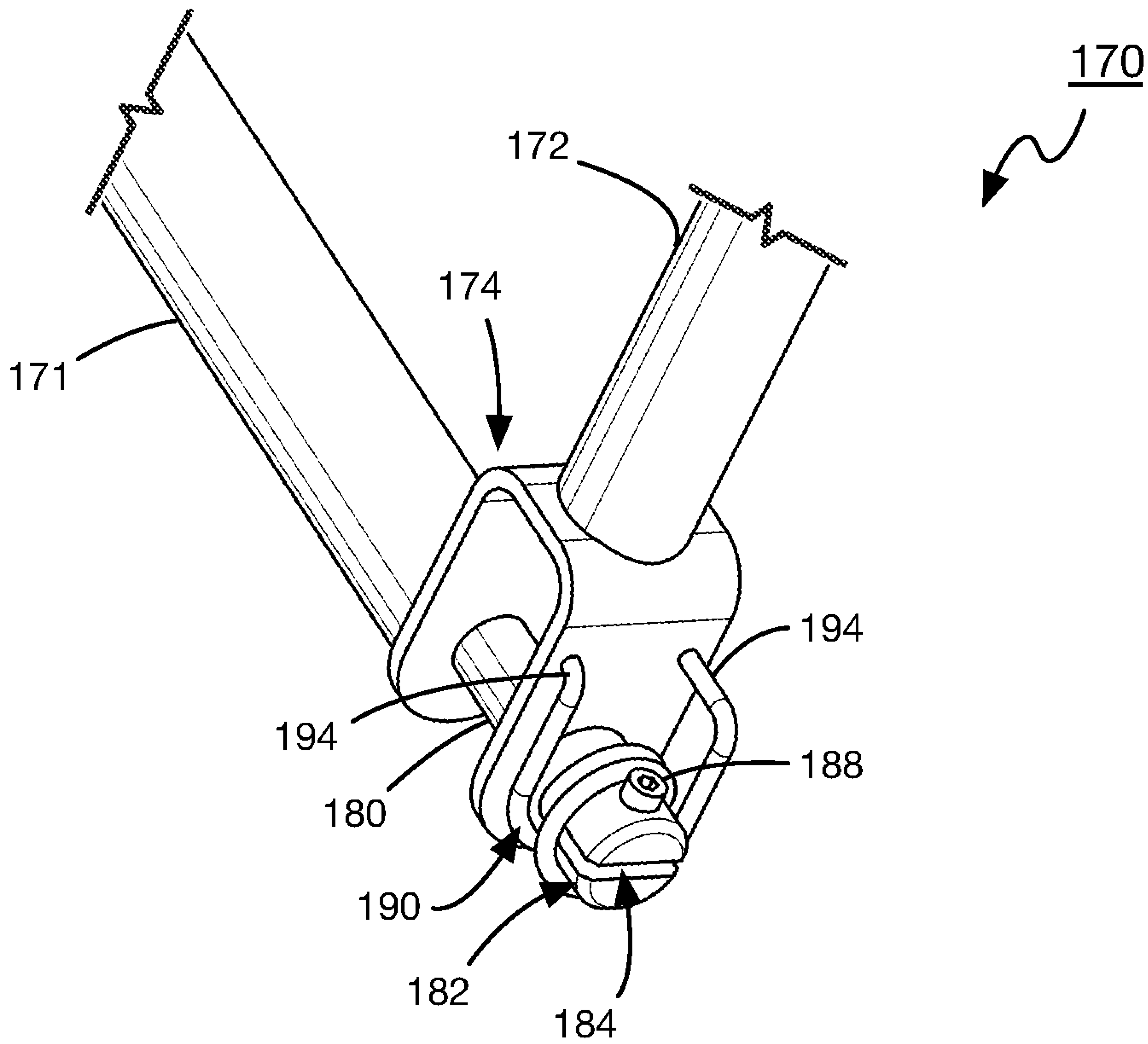

FIG. 18B

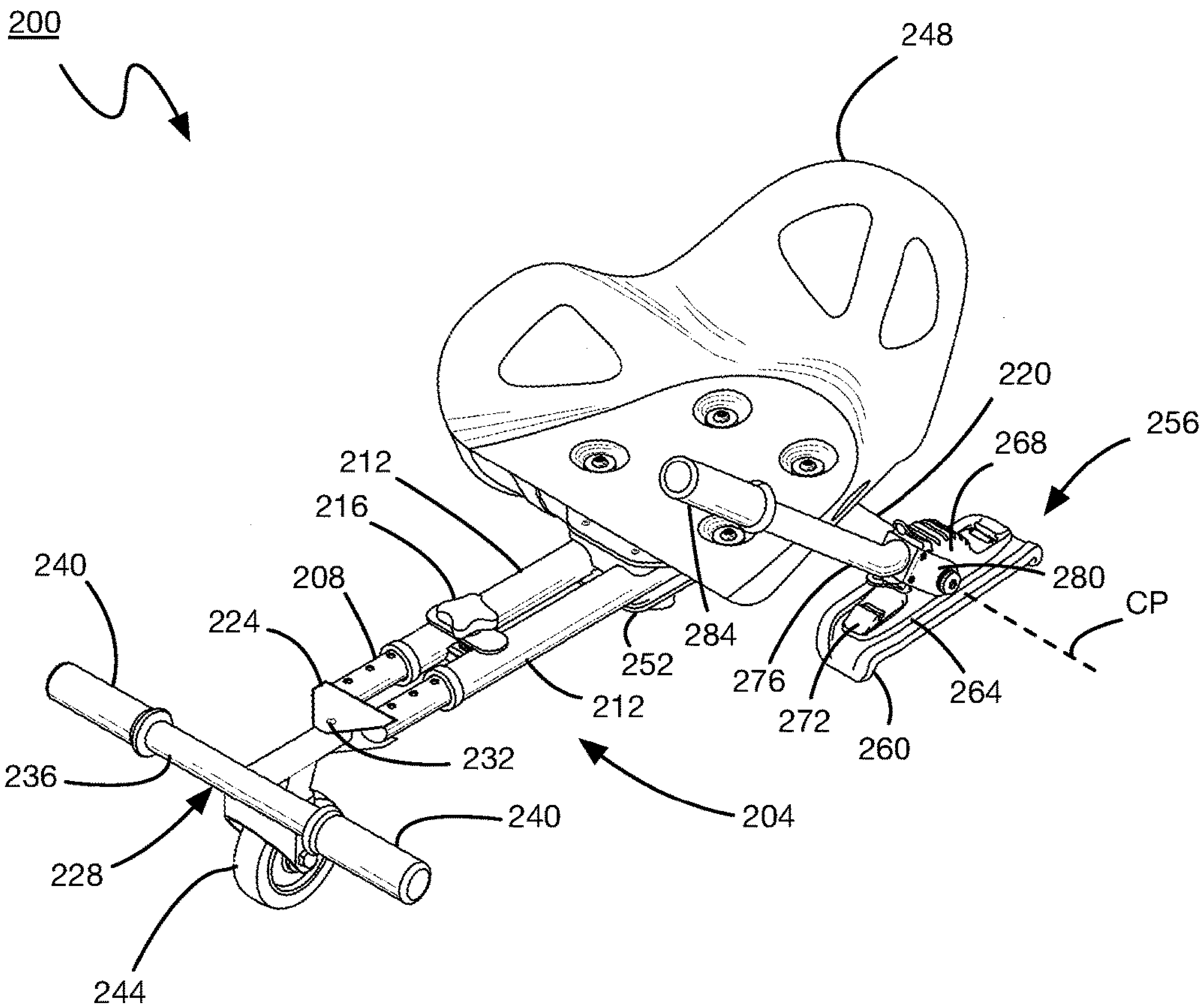

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FIG. 19

ACCESSORY FOR A SELF-BALANCING BOARD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 15/423,564, filed on Feb. 2, 2017, the contents of which are incorporated herein by reference in their entirety.

FIELD

The specification relates generally to powered personal transportation devices. In particular, the following relates to an accessory for a self-balancing board.

BACKGROUND OF THE DISCLOSURE

Self-balancing boards are well known in the industry. Such self-balancing boards, however, require considerable effort and skill for a rider to safely balance themselves while riding such boards. In addition, instability is inherent and thus a closed-loop feedback control system is required in order to maintain balance. This means that, if at any moment, the control effort is inadequate, the rider can easily fall from the vehicle. This can be the result of a malfunction of the vehicle, or by the rider providing an extreme, inadequate, or over input, such as a lean angle that would result in an output (such as a desired wheel torque or speed) that is beyond the capability of the vehicle or the rider's ability to self-balance on the self-balancing board. In either case, if the output required to maintain balance is not achievable, the rider will likely fall, potentially causing injuries to themselves or others, or property damage. When the rider does fall, the risk of bodily injury is high due to the height of the standing user from the ground. There have been numerous documented incidents where riders have fallen off of self-balancing boards, leading to injuries that range from minor scrapes all the way to broken bones and concussions.

SUMMARY OF THE DISCLOSURE

In one aspect, there is provided an accessory for a self-balancing board, the self-balancing board comprising a foot-deck having two lateral foot-deck ends, each lateral foot-deck end being coupled to a motor that drives a wheel in response to an orientation of the lateral foot-deck end relative to a horizontal plane, the accessory comprising a chassis, at least one travel surface-contacting element coupled proximal to a first longitudinal end of the chassis to facilitate travel of the chassis over a travel surface, a seat coupled to the chassis and configured to support a person, a first foot-deck engagement element proximal to a second longitudinal end of the chassis distal to the first longitudinal end and constructed to engage the foot-deck of the self-balancing board proximal to the first lateral foot-deck end, a second foot-deck engagement element proximal to the second longitudinal end of the chassis and constructed to engage the foot-deck of the self-balancing board proximal to the second lateral foot-deck end, and at least one control member coupled to the first foot-deck engagement element and the second foot-deck engagement element to control the orientation of the lateral foot-deck ends relative to a horizontal plane via the first foot-deck engagement element and the second foot-deck engagement element.

The at least one control member can comprise at least one control lever being coupled to the first foot-deck engagement element and the second foot-deck engagement element to control pivoting of the first foot-deck engagement element and the second foot-deck engagement element.

The accessory can further comprise a bridging member coupled to the first foot-deck engagement element and the second foot-deck engagement element to control pivoting of the first foot-deck engagement element and the second foot-deck engagement element relative to one another.

The at least one control lever can comprise a first control lever coupled to the first foot-deck engagement element and the second foot-deck engagement element to thereby control simultaneous pivoting of the first foot-deck engagement element and the second foot-deck engagement element.

The at least one control lever can comprise a first control lever coupled to the first foot-deck engagement element and a second control lever coupled to the second foot-deck engagement element.

The first foot-deck engagement element can be independently pivotable relative to the second foot-deck engagement element about a control pivot axis that is generally parallel to the rotation axis of the wheels of the self-balancing board.

Each of the first foot-deck engagement element and the second foot-deck engagement element can comprise an interface member constructed to interface with the foot-deck proximal to one of the lateral foot-deck ends and having at least two degrees of freedom of movement relative to the chassis.

Each of the first foot-deck engagement element and the second foot-deck engagement element can further comprise a control foot that is independently pivotable relative to the chassis about the control pivot axis that is generally parallel to the rotation axis of the wheels of the self-balancing board and is movably coupled to the interface member to enable movement of the control foot relative to the interface member.

The control foot can be pivotally coupled to the interface member about a torque pivot axis that is generally perpendicular to the control pivot axis.

The first foot-deck engagement element can be constructed to secure to the foot-deck of the self-balancing board proximal to the first lateral foot-deck end and the second foot-deck engagement element can be constructed to secure to the foot-deck of the self-balancing board proximal to the second lateral foot-deck end.

The first foot-deck engagement element can be constructed to releasably secure to the foot-deck of the self-balancing board proximal to the first lateral foot-deck end and the second foot-deck engagement element can be constructed to releasably secure to the foot-deck of the self-balancing board proximal to the second lateral foot-deck end.

Each of the first foot-deck engagement element and the second foot-deck engagement element can comprise a fastener for releasably securing the interface member against the foot-deck. The interface member can comprise the fastener. The fastener can comprise at least one of a strap, a clamp, and a magnetic element.

The control foot can be pivotally secured to the interface member. The fastener can couple directly to the control foot. The fastener can comprise at least one of a strap, a clamp, and a magnetic element. The interface member can comprise features restricting movement of the control foot relative to the interface member within a desired range.

Each of the control levers can be adjustably coupled to one of the foot-deck engagement elements and lockable in one of a set of orientations relative to the one foot-deck engagement element.

The interface member can comprise laterally extending lips that are constructed to overhang front and rear edges of the foot-deck to prevent movement of the interface member relative to the foot-deck.

The seat can be positioned proximal to the second end.

A position of the seat longitudinally along the chassis can be adjustable.

The at least one travel surface-contacting element can be a freely spinning wheel.

The accessory can further comprise a biasing structure biasing one of the first foot-deck engagement element and the at least one control lever to a position relative to the chassis wherein the foot-deck of the self-balancing board is unbiased away from a generally horizontal orientation when the accessory is positioned thereon.

The biasing structure can comprise at least one biasing spring biasing the one of the first foot-deck engagement element and the at least one control lever relative to the chassis.

The first foot-deck engagement element and the second foot-deck engagement element can be constructed to avoid contact with a central region of the foot-deck when the accessory is positioned thereon. The first foot-deck engagement element and the second foot-deck engagement element can have gaps positioned on the central region of the foot-deck when the accessory is positioned thereon.

In another aspect, there is provided a method of using a self-balancing board, comprising placing a first foot-deck engagement element of an accessory on a foot-deck of a self-balancing board proximal to a first lateral foot-deck end thereof, the self-balancing board further comprising a second lateral foot-deck end of the foot-deck, each of the first lateral foot-deck end and the second lateral foot-deck end being coupled to a motor that drives a wheel in response to an orientation of the lateral foot-deck end relative to a horizontal plane, the accessory further comprising a chassis having a first longitudinal end, and a second longitudinal end proximal to the first foot-deck engagement element, at least one travel surface-contacting element coupled proximal to a first longitudinal end of the chassis to facilitate travel of the chassis over a travel surface, a seat coupled to the chassis and configured to support a person, a second foot-deck engagement element proximal to the second longitudinal end of the chassis, and at least one control member coupled to the first foot-deck engagement element and the second foot-deck engagement element to control the orientation of the lateral foot-deck ends relative to a horizontal plane via the first foot-deck engagement element and the second foot-deck engagement element, and placing the second foot-deck engagement element on the foot-deck of the self-balancing board proximal to a second lateral foot-deck end thereof.

The at least one control member can comprise at least one control lever being coupled to the first foot-deck engagement element and the second foot-deck engagement element to control pivoting of the first foot-deck engagement element and the second foot-deck engagement element.

The method can further comprise releasably securing the first foot-deck engagement element to the first lateral foot-deck end, and releasably securing the second foot-deck engagement element to the second lateral foot-deck end.

BRIEF DESCRIPTIONS OF THE DRAWINGS

For a better understanding of the various embodiments described herein and to show more clearly how they may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings in which:

FIG. **1** is a perspective view of one type of a self-balancing board;

FIG. **2** is a perspective view of an accessory for the self-balancing board of FIG. **1** in accordance with an embodiment;

FIG. **3** is a side view of the accessory of FIG. **2**;

FIG. **4** is a front view of the accessory of FIG. **2**;

FIG. **5** is a top view of the accessory of FIG. **2**;

FIG. **6** is a partially exploded perspective view of the accessory of FIG. **2**;

FIG. **7** is a partially exploded perspective view of a portion of a foot-deck engagement element and a control lever of the accessory of FIG. **2** aligned with a portion of the foot-deck of the self-balancing board of FIG. **1**;

FIG. **8** is another partially exploded perspective view of the portion of a foot-deck engagement element and the control lever of the accessory of FIG. **2** aligned with a portion of the foot-deck of the self-balancing board of FIG. **1**;

FIG. **9** shows a perspective view of the portion of the foot-deck engagement element of the accessory of FIG. **2** aligned with a portion of the foot-deck of the self-balancing board of FIG. **1**;

FIG. **10** is a perspective view of the foot-deck engagement element of the self-balancing board of FIG. **2** aligned with a portion of the foot-deck of the self-balancing board of FIG. **1**;

FIG. **11** is a perspective view of the accessory of FIG. **2** aligned with the self-balancing board of FIG. **1**;

FIG. **12** is a perspective view of the accessory of FIG. **2** secured to the self-balancing board of FIG. **1**;

FIG. **13** is a perspective view of the accessory of FIG. **2** secured to the self-balancing board of FIG. **1** wherein the chassis has been extended longitudinally;

FIG. **14** is a perspective view of the accessory of FIG. **2** secured to the self-balancing board of FIG. **1**, wherein the seat has been positioned forward;

FIG. **15** is a perspective view of the accessory of FIG. **2** secured to the self-balancing board of FIG. **1**, wherein the control levers have been adjusted to a different angular position;

FIG. **16** is a top view of the accessory of FIG. **2** secured to the self-balancing board of FIG. **1**, wherein a control lever has been moved and a control foot pivoted relative to the interface member;

FIG. **17** is a perspective view of an accessory for use with the self-balancing board of FIG. **1** in accordance with another embodiment, wherein the interface members have gaps that are positioned on the central region of the foot-deck when the accessory is positioned thereon;

FIG. **18**A is a partial exploded view of a biasing spring for biasing a control lever of an accessory for use with the self-balancing board of FIG. **1** in accordance with yet another embodiment;

FIG. **18**B is a partial assembled view of the biasing spring and accessory of FIG. **18**A; and

FIG. **19** is a perspective view of an accessory for the self-balancing board of FIG. **1** in accordance with a still further embodiment.

REFERENCE NUMBER INDEX

10 self-balancing board
11 platform
12 wheel

13 foot-deck
14 lateral foot-deck end
15 front foot-deck edge
16 rear foot-deck edge
20 accessory for a self-balancing board
24 chassis
28 front cross-bar
30 front longitudinal end
32 longitudinal extension tube
36 telescoping longitudinal tube
40 locking knob
44 rear cross-bar
46 rear longitudinal end
48 foot rest
52 front wheel assembly
56 seat
60 top seat mounting bracket
64 bottom seat mounting bracket
68 seat mounting locking knob
72 foot-deck engagement element
76 control lever
80 control lever pivot bracket
84 control grip
FP front pivot axis
88 interface member
90 underside surface
92 laterally extending lip
96 top recess
100 lateral ridge
104 torque pivot post
108 control foot
112 pivot post aperture
116 positioning arch
120 pivot through-hole
124 position teeth
128 strap engagement hook
132 control lever pivot through-hole
136 pivot bolt
140 positioning lock release lever
CP control pivot axis
TP torque pivot axis
144 cinch strap
150 accessory
154 interface member
158 thicker end
162 gap
170 accessory
172 control lever
174 control lever pivot bracket
176 control pivot through-hole
178 pin-hole
180 pivot bolt
182 bolt head
184 deep slot
186 threaded hole
188 threaded screw
190 biasing spring
192 cross-portion
194 angled coil end
200 accessory
204 chassis
208 longitudinal extension tube
212 telescoping longitudinal tube
216 locking knob
220 rear cross-bar
224 pivot bracket
228 head assembly
232 head pivot bolt
236 front cross-bar
240 foot rest
244 front wheel assembly
248 seat
252 seat mounting bracket
256 master foot-deck engagement element
260 interface member
264 control foot
268 positioning arch
272 strap engagement hook
276 control lever
280 control lever pivot bracket
284 control grip

DETAILED DESCRIPTION

For simplicity and clarity of illustration, where considered appropriate, reference numerals may be repeated among the Figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the embodiments described herein. Also, the description is not to be considered as limiting the scope of the embodiments described herein.

Various terms used throughout the present description may be read and understood as follows, unless the context indicates otherwise: “or” as used throughout is inclusive, as though written “and/or”; singular articles and pronouns as used throughout include their plural forms, and vice versa; similarly, gendered pronouns include their counterpart pronouns so that pronouns should not be understood as limiting anything described herein to use, implementation, performance, etc. by a single gender; “exemplary” should be understood as “illustrative” or “exemplifying” and not necessarily as “preferred” over other embodiments. Further definitions for terms may be set out herein; these may apply to prior and subsequent instances of those terms, as will be understood from a reading of the present description.

Accessories for self-balancing boards are provided. The self-balancing boards have a foot-deck having two lateral foot-deck ends. Each lateral foot-deck end is coupled to a motor that drives a wheel in response to an orientation of the lateral foot-deck end relative to a horizontal plane. The accessory includes a chassis, at least one travel surface-contacting element coupled proximal to a first longitudinal end of the chassis to facilitate travel of the chassis over a travel surface, and a seat coupled to the chassis and configured to support a person. A first foot-deck engagement element is proximal to a second longitudinal end of the chassis distal to the first longitudinal end and is constructed to engage the foot-deck of the self-balancing board proximal to the first lateral foot-deck end. A second foot-deck engagement element is proximal to the second longitudinal end of the chassis and is constructed to engage the foot-deck of the self-balancing board proximal to the second lateral foot-deck end. At least one control member is coupled to the first foot-deck engagement element and the second foot-deck engagement element to control the orientation of the first and second lateral foot-deck ends relative to a horizontal plane via the first foot-deck engagement element and the second foot-deck engagement element.

The accessories use the self-balancing boards in a manner that differs from the method in which they were originally intended to be used. By adding at least one additional travel surface-contacting element, a rider may place their center of gravity over the area between the two wheels of the self-balancing board and the at least one travel surface-contacting element, thereby providing a stable stage to ride upon while still using the motor means of the self-balancing board to propel the self-balancing board and the accessory. Further, the accessories enable the lateral foot-deck ends to be actuated via at least one control member coupled to the foot-deck engagement elements to control the orientation of the lateral foot-deck ends of the self-balancing board relative to a horizontal plane.

A self-balancing board **10** is shown in FIG. **1**. The self-balancing board **10** has a platform **11** that spans between two wheels **12**. A foot-deck **13** of the platform **11** enables a rider to stand thereon. The foot-deck **13** is generally planar and may be textured and/or made from a material that provides traction between the foot of a rider and the platform **11**. The foot-deck **13** has two lateral foot-deck ends **14** adjacent the wheels **12**, a front foot-deck edge **15**, and a rear foot-deck edge **16**. The front foot-deck edge **15** and the rear foot-deck edge **16** represent the intersections between the front and back surfaces of the platform **11** and the foot-deck **13**.

A motor proximal to each lateral foot-deck end **14** powers the wheel adjacent to it. Each motor is operated to rotate the adjacent wheel **12** based on the pitch of the lateral foot-deck end **14** relative to a horizontal plane when the self-balancing board is upright. The platform **11** may be, in some cases, split into two platform halves that can pivot relative to each other around an axis that is generally coaxial or at least generally parallel to the rotation axis of the wheels **12**. In such cases, the orientation of the lateral foot-deck ends **14** can be determined via gyroscopes, accelerometers, or the like. In other cases, the platform **11** may be constructed to permit flexing of the platform **11**, thereby enabling one lateral foot-deck end **14** to pivot somewhat independently of the other lateral foot-deck end **14** as a result of torsion forces on the platform. The pivoting between the lateral foot-deck ends **14** can be determined using a strain gauge or the like.

If both lateral foot-deck ends **14** are similarly pitched in one direction, both adjacent motors will drive the self-balancing board in that direction at a similar speed, thus causing the self-balancing board to move in that direction. Alternatively, if both lateral foot-deck ends **14** are differently pitched in the same direction, the motors will drive the self-balancing board in that general direction, and the motor adjacent the more pitched lateral foot-deck end **14** will operate its associated wheel **12** more rapidly, causing the self-balancing board to turn in that direction. If one lateral foot-deck end **14** is pitched in one direction and the other lateral foot-deck end **14** is similarly pitched in the opposite direction, the motors will rotate the wheels in opposite directions, causing the self-balancing board **10** to rotate at its location.

An accessory **20** for the self-balancing board **10** of FIG. **1** in accordance with an embodiment is shown in FIGS. **2** to **6**. The accessory **20** is intended to enhance both the safety and enjoyment of the self-balancing board by effectively converting a traditional self-balancing board into a powered kart that, when ridden, generally lowers the rider's center of gravity. The accessory **20** includes a chassis **24** that has a front cross-bar **28** at a front longitudinal end **30**. Two parallel longitudinal extension tubes **32** extend backward from the front cross-bar **28** and are slidingly received within two parallel telescoping longitudinal tubes **36** and lockable at a number of positions via a locking knob **40**. The two telescoping longitudinal tubes **36** are adjoined to a rear cross-bar **44** at a rear longitudinal end **46** of the chassis **24**. The front cross-bar **28**, the longitudinal extension tubes **32**, the telescoping longitudinal tubes **36** and the rear cross-bar **44** can be made of any suitable material, such as aluminum or steel. The front cross-bar **28** is secured to the longitudinal extension tubes **32** via welding or another suitable approach. Similarly, the telescoping longitudinal tubes **36** are secured to the rear cross-bar **44** via welding or another suitable approach.

Two foot rests **48** are secured to opposite ends of the front cross-bar **28**. The foot rests **48** provide a place to position one's feet so that the rider's feet do not drag on a travel surface. The foot rests **48** can be used to carry the accessory **20** when it is not being ridden, either when the accessory **20** is secured to the self-balancing board **10** or detached from it. Further, the foot rests **48** can include heel rests in other embodiments to inhibit slippage of the rider's heels onto the travel surface. A front wheel assembly **52** is pivotally coupled to the front cross-bar **28** to enable the front wheel assembly **52** to swivel around a front wheel pivot axis FP that is generally vertically aligned when the accessory **20** is upright.

A seat **56** is shown secured to the telescoping longitudinal tubes **36** of the chassis **24** proximal to the rear longitudinal end **46** thereof via a top seat mounting bracket **60** and a bottom seat mounting bracket **64** that are clamped together atop of the telescoping longitudinal tubes **36** via a seat mounting locking knob **68**. The seat **56** can be a basic molded seat made of plastic or the like. Alternatively, the seat **56** can be provided with padding and/or suspension to make the rider's experience more enjoyable and to protect the rider from jarring while traveling over less smooth travel surfaces. The position of the seat **56** along the chassis **24** can be adjusted by loosening the seat mounting locking knob **68**, sliding the seat **56** forward or backward as desired, and then tightening the seat mounting locking knob **68**. The seat **56** may be mounted as low as possible to reduce the height of the center of gravity. This also brings the rider closer to the ground, reducing the chance of injury to the rider in the event of a fall.

A foot-deck engagement element **72** is pivotally coupled to each lateral end of the rear cross-bar **44** so that the foot-deck engagement elements **72** pivot about a control pivot axis CP.

The accessory **20** includes a control member for controlling the orientation of the lateral foot-deck ends **14**. The control members are, in this embodiment, a control lever **76** is coupled to each foot-deck engagement element **72** via a control lever pivot bracket **80**. The control lever **76** is typically constructed of steel or aluminum and welded to the control lever pivot bracket **80**. A control grip **84** mounted on the control lever **76** enables a rider to grip and manipulate the control lever **76**.

Referring now to FIGS. **1** to **10**, each foot-deck engagement element **72** includes an interface member **88** that is constructed to interface with the foot-deck proximal to one of the lateral foot-deck ends. The interface member **88** is made of a resilient compressible material, such as rubber, to engage the foot-deck **13** of the self-balancing board **10** proximal to a lateral foot-deck end **14** thereof. The interface member **88** is the portion of the accessory **20** that directly interfaces with and actuates the foot-deck. It has a generally flat underside surface **90** to enable a greater surface area of the underside surface **90** to engage the foot-deck **13** to thereby resist slippage. Two laterally extending lips **92** span the lateral width of the interface member **88** and engage the front and back foot-deck edges **15**, **16** of the platform **11** to prevent movement of the interface member **88** relative to the foot-deck **13**. A generally planar top recess **96** is formed between two lateral ridges **100** that extend along the longitudinal length of the foot-deck control surface **88**. A torque pivot post **104** extends upward from the top recess **96**.

A control foot **108** is dimensioned to fit within the top recess **96** of the interface member **88** and has a pivot post aperture **112** on its bottom surface to receive the torque pivot post **104** of the interface member **88**. The control foot **108** is the element of the assembly **20** that acts to pivot the lateral foot-deck ends **14** by application of pressure on the front and rear portions of the foot-deck. The control foot **108** can pivot about a torque pivot axis TP that is generally perpendicular to the control pivot axis CP, and defined by the torque pivot post **104** of the interface member **88** when the control foot **108** is held against it. The lateral ridges **100** of the interface member **88** limit movement of the control foot **108** to within a desired range. The control foot **108** and the torque pivot post **104** can be magnetized to keep the control foot **108** secured to the interface member **88** during assembly to prevent the interface member **88** from falling off of the control foot **108** during mounting/installation of the accessory **20** to the self-balancing board **10**.

A positioning arch **116** having an arcuate top surface is formed on the top surface of the control foot **108**. A pivot through-hole **120** passes laterally through the positioning arch **116**. Laterally extending position teeth **124** are formed along the top surface of the positioning arch **116**. A strap engagement hook **128** is formed on the top surface of the control foot **108** proximal to each of its front and rear ends.

A control lever pivot through-hole **132** extends laterally through the control lever pivot bracket **80**. The control lever pivot bracket **80** is fitted over the positioning arch **116** and a pivot bolt **136** is inserted through the control lever pivot through-hole **132** and the pivot through-hole **120** of the control foot **108** before it is secured to the rear cross-bar **44**. Positioning lock release levers **140** of the control lever **76** are releasably biased, such as via a spring, to engage the position teeth **124** to lock the angular position of the control lever **76** relative to the positioning arch **116**. Manual actuation of the positioning lock release levers **140** enables pivoting of the control lever **76** about the positioning arch **116** to adjust the angular position of the control lever **76** relative to the control foot **108**, and release of the positioning lock release levers **140** enables them to re-engage the position teeth **124** to thereby lock the angular position of the control lever **76**.

A cinch strap **144** is secured at each end of the control foot **108** via one of the strap engagement hooks **128**. The cinch strap **144** is made from a durable, flexible material such as hook-and-loop fabric or nylon.

FIG. **11** shows the assembled accessory **20** prior to being secured to the self-balancing board **10**. In order to secure the accessory **20** to the self-balancing board **10**, one end of the cinch straps **144** is undone. The interface members **88** are then aligned with and lowered onto the foot-deck **13** so that each interface member **88** is proximal to one of the lateral foot-deck ends **14**, with the laterally extending lips **92** of the interface members **88** overhanging the front foot-deck edges **15** and the rear foot-deck edges **16**. Each cinch strap **144** is then pulled underneath the platform **11** and secured to the other strap engagement hook **128** and tightened.

FIG. **12** shows the accessory **20** after the cinch straps **144** have secured it to the self-balancing board **10**. As can be seen, the cinch straps **144** are tightly secured to the platform **11** of the self-balancing board **10** so that pivoting of the control levers **76** causes the lateral foot-deck ends **14** of the self-balancing board **10** to pivot.

It may also be desirable to adjust various aspects of the accessory **20** for the rider. For example, the distance from the seat **56** to the foot rests **48** to accommodate for a rider's height or preference can be adjusted by loosening the locking knob **40**, and either pulling the longitudinal extension tubes **32** further out of the telescoping longitudinal tubes **36**, or by sliding the longitudinal extension tubes **32** further into the telescoping longitudinal tubes **36**.

FIG. **13** shows the accessory **20** after extension of the longitudinal extension tubes **32** out of the telescoping longitudinal tubes **36**, thereby providing a longer chassis **24**.

Another approach to changing this distance is to loosen the seat mounting locking knob **68** underneath the chassis **24**, sliding the seat forward or backward, and then tightening the seat mounting locking knob **68** again to retain the seat **56** in the new position.

FIG. **14** shows the seat **56** having been adjusted forward. As can be seen, the center of gravity of the rider is shifted forward. It can be advantageous in some scenarios to shift the rider's weight more to the front wheel assembly **52**, thereby reducing the chance that the accessory **20** will not tip up (perform a "wheelie") under strong acceleration via the self-balancing board **10**. In other scenarios, it may be desirable to move the seat **56** backwards to facilitate the performance of "wheelies" using the accessory **20**, which may be desirable for some less risk-averse or more skilled riders.

As will be appreciated, the length of the rider can be compensated for by adjusting both the extension of the longitudinal extension tubes **32** relative to the telescoping longitudinal tubes **36** and by adjusting the positioning of the seat **56** along the chassis **24**.

Yet another way in which the accessory **20** can be customized for a rider is by adjusting the angular position of the control levers **76** and thus the height of the control grips **84**. This is done on each side by manually pressing together the positioning lock release levers **140**, pivoting the control lever **76** to a desired angular position, and then releasing the positioning lock release levers **140** so that they can re-engage the position teeth **124** at the new angular position. The position teeth **124** define a number of angular positions in which the control levers **76** can be locked.

FIG. **15** shows the accessory **20** after adjustment of the control levers **76** to a different angular position. As shown, the control levers **76** have been pivoted about the control pivot axis and engage position teeth that are further back around the positioning arch from those engaged in the angular position of the control levers **76** shown in FIG. **12**.

Referring now to FIGS. **7** to **12**, operation of the accessory **20** will now be described. When the accessory **20** has been secured to the self-balancing board **10** and a rider is sitting in the seat **56**, part of the weight of the rider is distributed to the self-balancing board **10** via the interface members **88**. This helps to reduce slippage of the interface members **88** relative to the foot-deck **13**. The control levers **76** are secured to the control feet **108**, and both pivot about the control pivot axis P that is coaxial with the rear cross-bar **44** of the chassis **24**. The interface members **88** are held firmly in place atop of the foot-deck **13** by the tension of the cinch straps **144**. Forward and backward shifting of the control feet **108** within the top recess **96** is also inhibited by the torque pivot posts **104** being inserted in the pivot post apertures **112** of the control feet **108**, and by the longitudinal (front to rear) length of the control feet **108** in combination with the tautness of the cinch straps **144**.

When a rider is in the seat **56** of the accessory **20**, the rider can cause either wheel **12** of the self-balancing board **10** to which the accessory **20** is secured to accelerate in either a forward or backward direction. This is achieved by using the corresponding control lever **76** as a lever to pivot the lateral foot-deck end **14**. The control levers **76** freely pivot relative to the chassis **24**. Pivoting the control lever **76** in a direction applies a torqueing force to the corresponding lateral foot-deck end **14** by the force of the longitudinal end of the control foot **108** corresponding to the direction in which the control lever **76** is being pivoted on the lateral foot-deck end **14**, and by the tension of the cinch strap **144**.

The control levers **72** can be pivoted in either a forward or backward direction. Pivoting both control levers **76** by the same degree and in the same direction causes the wheels **12** to accelerate or decelerate in the direction to which the control levers are being pivoted **76**. Thus, a rider can elect to accelerate or decelerate in a forward direction or a backward direction, or stop.

Additionally, a rider can elect to pivot each control lever **76** to differing angles to cause a difference in the speed of the wheels **12**, thereby causing the combined self-balancing board **10** and the accessory **20** secured thereto to turn as it travels. The rider can even rotate the self-balancing board **10** and the accessory **20** secured thereto in a single location if one control lever **76** is pivoted to pivot the corresponding lateral foot-deck end **14** by an angular disposition in one direction, and if the other control lever **76** is pivoted to pivot the other lateral foot-deck end **14** by the same angular disposition in the opposite direction.

As the axis of pivoting of the lateral foot-deck end, typically the same as the rotation axis for the wheels for split foot-deck designs, is displaced from the control pivot axis P about which the interface members **88** pivot, the accessory **20** can be subject to tension and distortion forces when the angular position of one control lever **76** differs significantly from the angular position of the other control lever **76**. These tensions and distortion forces can cause the interface member **88** to twist on the foot-deck **13** if it is only permitted to pivot about the control pivot axis P; that is, to have one degree of freedom of movement. This twisting can leave undesirable marks on the foot-deck **13** of the self-balancing board **10**, and increase the resistance to rapidly turning the self-balancing board **10**.

FIG. **16** shows the accessory **20** secured to the self-balancing board **10** wherein the right control lever **76*a*** has been pivoted forward and downward, and the left control lever **76*b*** is in a neutral position. In order to reduce the amount of tension and/or distortion that the interface member **88** undergoes, the accessory **20** enables the control foot **108** to more than just pivot about the control pivot axis CP. In particular, the interface member **88** is held generally tightly against the foot-deck **13** of the self-balancing board **10**, and the control foot **108** is permitted to pivot relative to the interface member **88** about the torque pivot post **104** (that is, a second degree of freedom of movement) to reduce tension and torsional forces applied by the interface member **88** to the top surface of the foot-deck **13**. The lateral ridges **100** flanking the top recess **96** of the interface member **88** are features that act to restrict movement of the control foot **108** within a desired range. As the control foot **108** is somewhat tightly held against the platform **11** via the cinch strap **144**, it is inhibited from pulling away from the platform **11** enough to clear the lateral ridges **100**. Where the control levers **76** are pivoted to different angular dispositions and/or different directions, such as shown in FIG. **16**, the control feet **108** pivot on the pivot axis defined by the torque pivot post **104**. As a result, the right control foot **108*a*** has pivoted counter-clockwise relative to the torque pivot axis TP and the torque pivot post **104** of the right interface member **88*a***. The left control foot **108*b***, however, hasn't pivoted substantially relative to the left interface member **88*b***.

By enabling at least two degrees of freedom of movement between the chassis **24** and the interface member **88** and, in particular, rotation of the interface member **88** relative to an axis that is normal to the foot-deck **13** when the assembly **20** is mounted thereon, the chance of incidental damage to the foot-deck **13** by the foot-deck engagement element **72**, and resistance to pivoting of the control levers **76**, can be reduced in some scenarios.

Various other means for enabling two or more degrees of freedom of movement of the interface members and the chassis can be employed. For example, the foot-deck engagement elements can have interface members fixed in position relative to them, and the coupling between foot-deck engagement elements and the chassis can allow for the foot-deck engagement elements to both pivot about the control pivot axis and to wobble. The wobble would enable the play between the chassis and the foot-deck engagement elements to compensate for the relative movement of the positions along the foot-deck to which the foot-deck engagement elements are secured.

The accessory **20** can be removed from the self-balancing board **10** by releasing the cinch straps **144** from one of the strap engagement hooks **128**.

FIG. **17** shows an accessory **150** in accordance with another embodiment that is a slight variation of the accessory shown in FIGS. **1** to **14**, and employs an interface member **154** that is constructed with thicker ends **158** at the front and rear of the interface member **154** on the underside thereof. A resultant gap **162** is created in the middle of the interface member **154**. Some self-balancing boards are designed to maintain power to the motors while sensors in the middle of the foot-decks are triggered via pressure on the surface. As these sensors are generally centrally located in the foot-deck **13**, by only contacting the foot-deck **13** proximal to their front and back edges, such self-balancing boards can be turned off while the accessory **150** is secured thereto. That is, by avoiding contact with a central region of the foot-deck **13** in which the sensors are located when the accessory **150** is positioned thereon, actuation of the sensors can be avoided. The gaps **162** are positioned on the central region of the foot-deck **13** when the accessory **150** is positioned thereon.

In some cases, the weight of the control levers can, when unheld, lay in a forward position, creating a forward shift in the center of gravity atop of the foot-deck. This can cause a self-balancing board to commence moving forward, in the direction of the center of gravity. As a result, it can lead to undesired movement of the accessory and self-balancing board to which it's secured and possible injury or damage to the accessory or surrounding objects.

FIGS. **18**A and **18**B show a portion of another accessory **170** in accordance with a further embodiment that is a variation of the accessory shown in FIGS. **1** to **14**. Positioned beside a rear cross-bar **171** of a chassis of the accessory **170** is a control lever **172** has a control lever pivot bracket **174** with a control pivot through-hole **176** extending through it. In addition, the external lateral side of the control lever pivot bracket **174** has two pin-holes **178** passing through it. A pivot bolt **180** has a bolt head **182** with a deep slot **184** in its face. A threaded hole **186** extends through from a side of the bold head **182** and meets the deep slot **184**. A threaded screw **188** is dimensioned to be threadingly received within the threaded hole **186**. A biasing structure in the form of a biasing spring **190** has a cross portion **192**, with separate coils extending in counter directions from its ends. Each of the separate coils has an angled coil end **194**, both of which are generally parallel.

During assembly, the pivot bolt **180** is inserted through the control pivot through-hole **176** of the control lever pivot bracket **174** and threaded into the rear cross-bar **171**. The pivot bolt **180** is tightened and the deep slot **184** is aligned generally perpendicular to the desired neutral resting orientation of the control lever **172**. The cross portion **192** of the biasing spring **190** is placed into the deep slot **184** and moved towards the back of the deep slot **190**. The threaded screw **188** is then threaded through the threaded hole **186** until it encloses the cross portion **192** of the biasing spring **190** within the deep slot **184**. Then, each of the angled coil ends **194** are inserted into a corresponding one of the pin-holes **178** and secured therein, such as by bending, taping, etc.

The biasing spring **190** is thus able to exert a net biasing force (as a result of the two portions of the biasing spring **190**) on the control lever **172** towards an angular position relative to the chassis in which the center of gravity of the accessory **170** on the self-balancing board is sufficiently centered to avoid triggering motion of the self-balancing board in either a forward or a backward direction. That is, the foot-deck **13** of the self-balancing board **10** is not biased away from a generally horizontal orientation when the accessory is positioned thereon. This net biasing force, however, can readily be overcome by manually pivoting the control levers **172** in a forward or backward direction. The biasing spring **190** is sufficiently resilient to maintain a sufficient net biasing force on the control levers **172** over the lifetime of the accessory **170**.

While, in this illustrated embodiment, the biasing structure is a single spring element, more than one biasing spring can be employed. Further, other types of biasing structures can be employed. For example, leaf springs can be employed so that pivoting of the control levers bends the leaf springs, thereby causing them to exert a biasing force on the control levers towards an angular position in which the center of gravity of the accessory on the self-balancing board is sufficiently centered. In another example, compressible members coupled to the pivot bolt can apply a biasing force on the control levers when they are pivoted away from an angular position in which the center of gravity of the accessory on the self-balancing board is sufficiently centered.

In other embodiments, biasing structures can be employed to bias the foot-deck engagement elements relative to the chassis so that, when the accessory is positioned on a self-balancing board, the foot-deck of the self-balancing board is unbiased away from a generally horizontal orientation.

FIG. **19** shows an accessory **200** in accordance with another embodiment. The accessory **200** has a chassis **204** that includes two parallel longitudinal extension tubes **208** that are slidingly received within two parallel telescoping longitudinal tubes **212** and lockable at a number of positions via a locking knob **216**. The two parallel telescoping longitudinal tubes **212** extend from a rear cross-bar **220** at the rear. The two longitudinal extension tubes **208** are joined to a pivot bracket **224**. A head assembly **228** is coupled to the pivot bracket **224** and pivots about a vertically mounted head pivot bolt **232**. The head assembly **228** includes a front cross-bar **236** having a pair of foot rests **240** at its lateral ends. A front wheel assembly **244** is mounted in a fixed orientation at the bottom of the head assembly **228**. A seat **248** is mounted on the telescoping longitudinal tubes **212** via a seat mounting bracket **252**.

A master foot-deck engagement element **256** at a first lateral end of the rear cross-bar **220** is coupled via a bridging member in the form of a linkage that passes through the rear cross-bar **220** to a slave foot-deck engagement element (not shown) so that they pivot together about a control pivot axis P. The master foot-deck engagement element **256** is similar to the foot-deck engagement elements of the accessory shown in FIGS. **1-14**. It includes an interface member **260** and a control foot **264** that rests within a top recess thereof and pivots about a pivot post extending vertically from the interface member **260**. The control foot **264** has a positioning arch **268** that has laterally extending position teeth around its periphery. A strap engagement hook **272** is formed on the top surface of the control foot **264** proximal to its front and rear ends. The slave foot-deck engagement element also has an interface member and a control foot similar to those of the master foot-deck engagement element, except that it does not have a positioning arch.

A control lever **276** is pivotally coupled to the positioning arch **268** via a control lever pivot bracket **280** so that it pivots around a control pivot axis P. The control lever **276** has a control grip **284** at its other end to enable a rider to grasp and control pivoting of the control lever **276** with one hand. The angular position of the control lever **276** can be adjusted via two positioning lock release levers.

The accessory **200** can be secured to a self-balancing board such as the one illustrated in FIG. **1** in the same way that the accessory **20** of FIGS. **1** to **14** is secured to it. The accessory **200** uses the self-balancing board as a motor means for propelling the combined accessory **200** and self-balancing board. By pivoting the control lever **276**, the rider can control the pitch of the lateral foot-deck ends of the self-balancing board. As both the master foot-deck engagement element **256** and the slave foot-deck engagement element are pivotally fixed relative to each other, pivoting of the control lever **276** pivots the pitch of both lateral foot-deck ends simultaneously. As a result, both wheels accelerate or decelerate in the same direction at the same time. Steering of the accessory **200** is achieved by the rider pivoting the head assembly **228** using their feet. As the front wheel assembly **244** is fixed relative to the head assembly **228**, it pivots with the head assembly **228** to steer the accessory **200** and the self-balancing board to which the accessory **200** is secured.

While control levers are employed in the above described embodiments to control the orientation of the lateral foot-deck ends of the self-balancing board, other control members can be employed for this purpose. For example, an accessory can have a chassis that is hinged partway along its longitudinal length and has a biasing structure for biasing a front chassis portion relative to a rear chassis portion about the hinge. For example, the front chassis portion may be biased relative to the rear chassis portion to a position where the chassis portions meet at an angle of 150 degrees, and the biasing structure permits pivoting of the front chassis portion and the rear chassis portion to lessen or greaten the angle between them. The front chassis portion can have a wheel and foot rests proximal to its front end, and the rear chassis portion can have a seat proximal to its rear end. Further, the rear chassis can include control members in the form of frame elements that are coupled relatively fixedly to two foot-deck engagement elements that can be positioned on the foot-deck of a self-balancing board proximal to its lateral ends. By extending their legs, a rider can cause the front and rear chassis portions to straighten, thereby reorienting the foot-deck engagement portions attached to the control members of the rear chassis portion, and the foot-deck ends of the self-balancing board with it to cause the self-balancing board to propel forward. Similarly, by pulling their feet closer, a rider can cause the front and rear chassis portions to contract, reducing the angle between them, thereby reorienting the foot-deck engagement portions attached to the control members of the rear chassis portion, and the foot-deck ends of the self-balancing board with it to cause the self-balancing board to reverse.

While the accessory in the embodiments described above has a single wheel assembly, it may be desirable to employ two or more wheels on the accessory, thereby providing four or more wheels on the combined accessory and self-balancing board.

Other types of travel surface-contacting elements to facilitate travel of the chassis over a travel surface other than wheels can be employed for the accessory. For example, the accessory can be fitted with a ski runner that could be used over indoor flooring, grass, snow, etc. In another embodiment, a tank track could be deployed on the accessory.

The length and orientation of the control lever(s) may be made to be adjustable in a variety of manners, such as the angle that they extend from the pivot brackets (the angular position), the angle at which they extend laterally away from a vertical axis, etc.

While, in the above-described embodiments, the control lever is separate from the foot-deck engagement element, in other embodiments, the control lever and the foot-deck engagement element can be manufactured as a unitary element or assembly. While the angular position of the control levers would not be adjustable relative to the foot-deck engagement elements, production costs may be reduced and product durability may be increased in some scenarios.

Where, in the above-described and illustrated embodiments, cinch straps are used to releasably secure the accessories to self-balancing boards, other means for securing the accessory to the self-balancing board can be employed. For example, the accessory may be bonded to the platform, although this approach would not allow the self-balancing board to be separable from the accessory. In another example, the accessory may be magnetically coupled to the self-balancing board via a magnetic element, thereby enabling the accessory to be removed from the self-balancing board when desired. Further, the foot-deck engagement elements may simply rest on the self-balancing board without securing the accessory thereto. In a further embodiment, the foot-deck engagement elements can releasably clamp onto the platform of the self-balancing board.

The accessories can be made to accommodate self-balancing boards of various shapes and sizes.

The seat can be made unitarily with the chassis in some embodiments.

Various types and configurations of chasses can be employed to provide a platform.

More sophisticated pedal or foot straps can be employed to further secure the rider.

Persons skilled in the art will appreciate that there are yet more alternative implementations and modifications possible, and that the above examples are only illustrations of one or more implementations. The scope, therefore, is only to be limited by the claims appended hereto.

The invention claimed is:

1. A vehicle assembly, comprising:

a self-balancing board, having the self-balancing board comprising a foot-deck having two lateral foot-deck ends, each lateral foot-deck end being coupled to a motor that drives a wheel in response to an orientation of the lateral foot-deck end relative to a horizontal plane; and

an accessory including:

a chassis;

at least one travel surface-contacting element coupled proximal to a first longitudinal end of the chassis to facilitate travel of the chassis over a travel surface;

a seat coupled to the chassis and configured to support a person;

a first foot-deck engagement element proximal to a second longitudinal end of the chassis distal to the first longitudinal end and constructed to engage the foot-deck of the self-balancing board proximal to the first lateral foot-deck end;

a second foot-deck engagement element proximal to the second longitudinal end of the chassis and constructed to engage the foot-deck of the self-balancing board proximal to the second lateral foot-deck end; and

at least one control member coupled to the first foot-deck engagement element and the second foot-deck engagement element to control the orientation of the lateral foot-deck ends relative to a horizontal plane via the first foot-deck engagement element and the second foot-deck engagement element.

2. A vehicle assembly according to claim **1**, wherein the at least one control member comprises at least one control lever being coupled to the first foot-deck engagement element and the second foot-deck engagement element to control pivoting of the first foot-deck engagement element and the second foot-deck engagement element.

3. A vehicle assembly according to claim **2**, further comprising a bridging member coupled to the first foot-deck engagement element and the second foot-deck engagement element to control pivoting of the first foot-deck engagement element and the second foot-deck engagement element relative to one another.

4. A vehicle assembly according to claim **3**, wherein the at least one control lever comprises a first control lever coupled to the first foot-deck engagement element and the second foot-deck engagement element to thereby control simultaneous pivoting of the first foot-deck engagement element and the second foot-deck engagement element.

5. A vehicle assembly according to claim **2**, wherein the at least one control lever comprises a first control lever coupled to the first foot-deck engagement element and a second control lever coupled to the second foot-deck engagement element.

6. A vehicle assembly according to claim **5**, wherein the first foot-deck engagement element is independently pivotable relative to the second foot-deck engagement element about a control pivot axis that is generally parallel to the rotation axis of the wheels of the self-balancing board.

7. A vehicle assembly according to claim **6**, wherein each of the first foot-deck engagement element and the second foot-deck engagement element comprises an interface member constructed to interface with the foot-deck proximal to one of the lateral foot-deck ends and having at least two degrees of freedom of movement relative to the chassis.

8. A vehicle assembly according to claim **7**, wherein each of the first foot-deck engagement element and the second foot-deck engagement element further comprises a control foot that is pivotable relative to the chassis about the control pivot axis that is generally parallel to the rotation axis of the wheels of the self-balancing board and is movably coupled to the interface member to enable movement of the control foot relative to the interface member.

9. A vehicle assembly according to claim **8**, wherein the control foot is pivotably coupled to the interface member about a torque pivot axis that is generally perpendicular to the control pivot axis.

10. A vehicle assembly according to claim **9**, wherein the first foot-deck engagement element is constructed to secure to the foot-deck of the self-balancing board proximal to the first lateral foot-deck end and the second foot-deck engagement element is constructed to secure to the foot-deck of the self-balancing board proximal to the second lateral foot-deck end.

11. A vehicle assembly according to claim **10**, wherein the first foot-deck engagement element is constructed to releasably secure to the foot-deck of the self-balancing board proximal to the first lateral foot-deck end and the second foot-deck engagement element is constructed to releasably secure to the foot-deck of the self-balancing board proximal to the second lateral foot-deck end.

12. A vehicle assembly according to claim **11**, wherein each of the first foot-deck engagement element and the second foot-deck engagement element comprises a fastener for releasably securing the interface member against the foot-deck.

13. A vehicle assembly according to claim **12**, wherein the interface member comprises the fastener.

14. A vehicle assembly according to claim **13**, wherein the fastener comprises at least one of a strap, a clamp, and a magnetic element.

15. A vehicle assembly according to claim **14**, wherein the control foot is pivotally secured to the interface member.

16. A vehicle assembly according to claim **12**, wherein the fastener couples directly to the control foot.

17. A vehicle assembly according to claim **16**, wherein the fastener comprises at least one of a strap, a clamp, and a magnetic element.

18. A vehicle assembly according to claim **17**, wherein the interface member comprises features restricting movement of the control foot relative to the interface member within a desired range.

19. An accessory for a self-balancing board, the self-balancing board comprising a foot-deck having two lateral foot-deck ends, each lateral foot-deck end being coupled to a motor that drives a wheel in response to an orientation of the lateral foot-deck end relative to a horizontal plane, the accessory comprising:

a chassis;

at least one travel surface-contacting element coupled to the chassis to movably support the accessory on a travel surface;

a seat coupled to the chassis and configured to support a person;

a first foot-deck engagement element coupled to the chassis at a point spaced from at least one travel surface-contacting element and constructed to engage the foot-deck of the self-balancing board proximal to the first lateral foot-deck end;

a second foot-deck engagement element coupled to the chassis at a point spaced from at least one travel surface-contacting element and constructed to engage the foot-deck of the self-balancing board proximal to the second lateral foot-deck end; and

a first control lever coupled to the first foot-deck engagement element and a second control lever coupled to the second foot-deck engagement element, wherein the first and second control levers are movable to control the orientation of the lateral foot-deck ends relative to a horizontal plane via the first foot-deck engagement element and the second foot-deck engagement element,

wherein the first foot-deck engagement element is independently pivotable relative to the second foot-deck engagement element about a control pivot axis that is generally parallel to the rotation axis of the wheels of the self-balancing board,

wherein each of the first foot-deck engagement element and the second foot-deck engagement element comprises an interface member constructed to interface with the foot-deck proximal to one of the lateral foot-deck ends and having at least two degrees of freedom of movement relative to the chassis.

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